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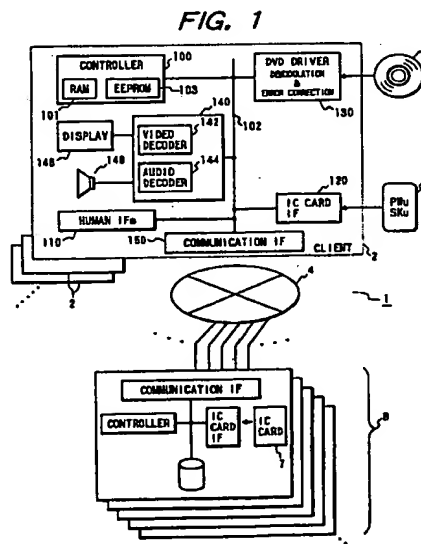
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(54) System and method for controlling the use of a package of distributed application software

(57) A system for permitting only an authentic user to play a desired application contained in a distributed application package in one of predetermined operation, e.g., free play mode, charged mode, limit-attached play mode, etc. The system comprises a client for playing an application under the control of a server connected with the client through a communication network. The application package (the volume) includes a distribution descriptor which contains mode codes assigned to the volume and the applications of the volume. The data of distribution descriptor is decided and stored in the descriptor at the time of distribution of the volume. This feature makes the system flexible. There is also disclosed a system operatable without communicating with a server.



EP 0 840 194 A2

Description

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention generally relates to a security system and, more specifically, to a method and system for permitting an authentic user to use charged information which has been distributed via package or transmission media while charging and controlling the use of distributed charged information.

2. Description of the Prior Art

In order to use charged information such as music, movies, games, etc. provided by information providers that provide various programs of such charged information, a user has generally to take two steps. In the first step (or obtaining step), the user obtains a desired program from one of the information providers by purchasing a package media such as an FD (floppy disc), an optical disc (e.g., CD-ROM (compact disc read only memory) and DVD (digital versatile disc or video disc)), etc. on which the desired program is recorded (off-line distribution or obtaining) or by downloading the desired program from the server computer of an information provider through a predetermined procedure (on-line distribution or obtaining). In case of the on-line obtaining, the user may either play the program while obtaining it (i.e., the two steps are executed in parallel) or store the program while obtaining it in the first step and execute the program later as the second step (or using step). In case of the off-line obtaining, in the second step the user loads the obtained recording media into an appropriate device and directly plays (or executes) the program or once stores the program into the memory of the device and then plays the program.

Japanese Patent unexamined publication No. Hei7-295674 (1995) discloses a security system for use in the second or using step for a CD-ROM. In this system, the user can use encrypted information which is recorded together with a public key of a toll center (a center public key) on a CD-ROM by encrypting with the center public key and sending a code of desired program included in the information and a user-generated key to the information provider and by decrypting the information with an encryption key which has been encrypted with the user-generated key and sent by the information provider. However, the identity of the user is not verified, permitting a mala fide user who have obtained other person's CD-ROM to use it. Further, the center public key is pressed together with the encrypted information on the CD-ROM. This makes it difficult to change the center public key. Also, this causes different providers who probably want to use different center public keys to force the CD-ROM manufacturer to use different masters (or stampers) in pressing the CD-ROMs.

Japanese Patent unexamined publication No. Hei7-288519 (1995) discloses a security system for use in both the first and second steps. However, this system is only applicable to a system in which charged information is distributed on line.

Japanese Patent unexamined publication No. Hei8-54951 (1996) discloses a system in which the quantity of used software is monitored, and further software use by the user is impeded if the quantity exceeds a predetermined quantity. Since a dedicated hardware is necessary for impeding of software use, this system is only suitable for the use in a server in a on-line distribution system.

There is also a system for permitting a user to use, only for a trial period, software which has been distributed with data defining the trial period. In this system, a mala fide user may make the software reusable by installing the software again or setting the user system clock for a past time.

There are these and other programs in the art. It is an object of the invention to provide a system for permitting only an authentic user (a user who have legally obtained charged information either on line or off line from an information provider) to use the charged information without any limitation, charging for each time of its use, or within the tolerance of a use-limiting factor (e.g., the quantity used, the days elapsed since the day of its purchase or the current date) according to the type of the charged information.

SUMMARY OF THE INVENTION

According to the principles of the invention, it is assumed that charged information or an application package is distributed, either via package (or recording) media or via transmission media, together with at least control information such as a media title and a media code, etc. However, an illustrative embodiment will be described mainly in conjunction with charged information recorded on and distributed by means of the DVD.

For any type of charged information, charged information has been encrypted with a key and recorded on a DVD when obtained by a user. If distributed charged information to be played is of the limitlessly playable type, the charged information processing is achieved in the following way: the key is first obtained in a user public key-encrypted form from

the DVD on which the key has been recorded at the time of selling the DVD; the user public key-encrypted key is decrypted with a user secret key stored in a IC card into a decrypted key; and the encrypted charged information is decrypted with the decrypted key and consumed (that is, played or executed). The user-public key-encrypted key may be obtained on line from the server serving the client (device).

If distributed charged information to be played is of the usage-sensitive charging type, the user is charged for each time of using the information. In this case, prior to processing the charged information, the client double-encrypts and sends a user's credit card number to one of the to 11 servers of the provider of the information; the server adds an amount (e.g., play time or duration) used associated with the information to the value in a total amount (software meter) field in a volume data table, and sends the updated total amount value to the client; and the client displays the updated total amount. Then the client starts the charged information processing.

If distributed charged information to be played is of the limit-attached type, that is, the use of the information is to be limited by the tolerance of a certain limiting factor concerning the information consumption, then the client is permitted to consume the charged information only if the use-limiting factor is within the preset limit. In case of this type of charged information, prior to processing the charged information, the client sends the identifier (ID) code of a user specified application which is recorded on the DVD to the server; on receiving the ID code the sever tests if the use-limiting factor associated with the user specified application is within the preset limit; if not, then the server informs the client of the test result, and the client displays the test result; if the test was successful, then the server updates the meter (or integrated value) of the use-limiting factor and sends the updated value to the client; and in response to the reception of the updated value the client displays the updated value. Then the client starts the charged information processing.

BRIEF DESCRIPTION OF THE DRAWING

Further objects and advantages of the present invention will be apparent from the following description of the preferred embodiments of the invention as illustrated in the accompanying drawings. In the drawing,

FIG. 1 is a block diagram showing an arrangement of a system for permitting a user to use a distributed application package on the terms of use of the package with a higher security according to a first illustrative embodiment of the invention;

FIG. 2 is a diagram showing an exemplary structure of an application (or a charged information) package recorded on a DVD used in the inventive system;

FIGs. 3 and 4 are diagrams showing, in a detailed form, exemplary data structures of the volume descriptor 22 and the distribution descriptor 23, respectively;

FIG. 5 is a flow chart of a volume control program for playing the application(s) recorded on the DVD according to the principle of the invention;

FIG. 6A is a diagram showing an exemplary structure of a volume data table stored in a server shown in FIG. 1;

FIG. 6B is a diagram showing an exemplary structure of a application data table stored in a server 8;

FIG. 7 is a diagram showing a structure of a server table 75 stored in the EEPROM 103 of the client 2;

FIGs. 8A and 8B are flow charts of initial routines executed interactively by the client 2 and the server 8, respectively, at the beginning of the processes 650, 700 and 800.

FIG. 9 is a flow chart showing a procedure of a free play process shown as step 650 in FIG. 5, wherein connecting adjacent blocks by two flow lines indicates that each block is executed interactively by a client and an associated server;

FIGs. 10A and 10B are flow charts jointly showing a procedure formed of exemplary expected play time informing routines interactively executed;

FIGs. 11A and 11B are flow charts jointly showing a procedure formed of exemplary timed play and metered usage report routines interactively executed for playing an application while timing the duration and displaying a timed play duration after the play;

FIGs. 12A and 12B are flow charts jointly showing a procedure formed of exemplary timed application-play subroutines interactively executed for playing the application while timing the duration;

FIGs. 13A and 13B are flow charts jointly showing a procedure formed of alternative timed application-play subroutines interactively executed in which timing of play time is achieved with a timer in the client;

FIG. 14 is a flow chart of an exemplary application play subroutine called in steps 612 and 622 of FIGs. 12A and 13A, respectively, and executed by the controller 100;

FIG. 15 is a flow chart showing a procedure of a charged play process 700 shown as step 700 in FIG. 5,

FIGs. 16A and 16B are flow charts jointly showing a procedure formed of exemplary expected charge informing routines interactively executed;

FIGs. 17A and 17B are flow charts jointly showing a procedure formed of routines interactively executed in block 650 of FIG. 15;

FIGs. 18A and 18B are flow charts jointly showing a procedure formed of exemplary timed play and metered charge report routines interactively executed for playing an application while timing the duration and displaying a charge and a total amount of charges after the play;

FIG. 19 is a flow chart showing a procedure interactively executed by the client 2 and the server 8 in the operation block 800 of FIG. 5, wherein blocks connected with two flow lines indicates that operation of the blocks is done by the two elements 2 and 8;

FIGs. 20A and 20B are a key-encrypting key table and a user's public key table, respectively, stored in the server; and

FIG. 20C is a flow chart of a process for obtaining the application encrypting key K_v from the server 8;

FIG. 21 is a block diagram of an exemplary decipherer-built-in IC card IF according to the invention;

FIG. 22 is a diagram showing a K_v decoder used in place of the K_v decoder 126 of FIG. 21 in a system 1 using the cryptosystem of FIG. 20C;

FIG. 23 is a diagram for explaining the meanings of the terms-of-use (TOU) codes and the corresponding limit values;

FIG. 24 is a block diagram showing an arrangement of a system for playing a distributed application package on the terms of use of the package without communicating with any server according to a second illustrative embodiment of the invention;

FIG. 25 is a flow chart schematically showing an exemplary control program executed by the controller 100a shown in FIG. 24;

FIGs. 26 and 27 are flow charts showing an operation of a free play mode shown in step 650a of FIG. 25 in a detailed form and a further detailed form, respectively; and

FIG. 28 is a flow chart showing an operation of a limit-attached play mode shown in step 800a of FIG. 25.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

For the sake of better understanding of the following description, it will be useful to define some terms to be used. Charged information provided by an information provider may be distributed off-line (in off-line distribution) or on-line (in on-line distribution). In off-line distribution, the charged information is recorded on package media or recording media, and distributed through the sales network of the provider, that is, sold at stores in the sales network. The package media include all sorts of portable recording media such as various types of magnetic discs, a variety of optical memory discs (e.g., CD, CD-ROM, DVD), and magnetic tapes and cartridges. In on-line distribution, the charged information is transmitted via transmission media from the servers at the service points of the provider and the distributors aligned with the provider to the client device (e.g., PC (personal computer)) of the user who requested the charged information, and stored in a recording media of the client (device). The transmission media include any telecommunication channels which permit data communication between the servers and the client device. The package media and the transmission media are hereinafter referred to en bloc as "distribution media".

The charged information may be any type of software such as music, movies, games, etc. which are each referred to as an "application" without discrimination. The distribution unit of charged information is referred to as a "charged information package" or an "application package". There may be included one or more applications in an application package.

The present invention relates to a system for permitting a user to use a distributed application package on the terms of use of the package with a higher security.

Embodiment 1

For the purpose of simplicity, a first illustrative embodiment will be described in which package media, among other things, DVDs are used as distribution media.

FIG. 1 is a block diagram showing an arrangement of a system for permitting a user to use the application(s) recorded on a DVD on the terms of use of the DVD with a higher security according to the first illustrative embodiment of the invention. In FIG. 1, the system 1 comprises a client or DVD player 2 which plays a DVD 3, a telecommunication network 4, and a server 8 at a toll center of the provider 6 which provides the application package of the DVD 3.

FIG. 2 is a diagram showing an exemplary structure of an application (or a charged information) package 20 recorded on the DVD 3 used in the inventive system 1. In FIG. 2, the application package 20 comprises at least one application 21, a volume (or package) descriptor 22 comprising data concerning the application package 20, and a distribution descriptor 23 comprising data which is determined mainly at the time of, e.g., distribution or sales after the pressing of the DVD 3. (The volume descriptor 22 and the distribution descriptor 23 constitutes the volume control data of the volume 20.) In this embodiment it is assumed that a volume (or package) control program which controls the use of the application package 20 in cooperation with the server 8 is included in and distributed with the application package

20. Thus, the application package 20 further comprises the package control program 24 suited for the terms of use of the package 20. The application(s) 21, the volume descriptor 22 and the package (or volume) control program 24 are recorded in the data area of the DVD 3 at the time of manufacturing the DVD 3, while the distribution descriptor 23 is recorded in the burst cutting area at the time of, e.g., sales of the DVD 3.

FIGs. 3 and 4 are diagrams showing, in a detailed form, exemplary data structures of the volume descriptor 22 and the distribution descriptor 23, respectively. In FIG. 3, the volume descriptor 22 at least contains a volume identifier (VID_v) 25 which the title of the application package 20 is probably used for and which is the same as the application identifier if the package or volume 20 contains only one application; a provider identifier 26; volume creation date and time 27 which may be used for the base point by which volume expiration data and time as described later is determined; and volume effective date and time 28 indicative of date and time until which the volume 20 is available. If the volume 20 contains more than one applications, the volume descriptor 22 further contains application identifiers (AID_a's) 29.

In FIG. 4, the distribution descriptor 23 comprises the fields of: a volume issue number (NO_v) 30 which contains a serial number given to each of the distributed application packages of an identical volume identifier (volume ID or title) VID_v in the order of distribution; a server public key (PK_s) 31 the data of which is given by the server 6 at a toll center of the provider 6; a PK_u (user-public-key)-encrypted application-encrypting key (K_v) 32; and sales date and time 33. The key PK_s 31 field contains a key which has been used in encrypting each application 21 in the package 20 and which has been encrypted with a user public key (PK_u) of the user who has legally obtained the package 20. Appropriate data are recorded in all of the fields 30 through 34 at the time of distribution of the package 20, i.e., at the time of sales of the DVD 3 in this embodiment.

The distribution descriptor 23 further comprises the field 34 of terms-of-use code (mode code) plus limit value for the volume (the volume limit value field) and, for each of the application IDs 29, the fields 35 of terms-of-use code plus limit value for the application ID 29 (application limit value field). If terms of use are set only to the volume 20, there is no need of the field 35. If terms of use are set to each application, the field is empty.

FIG. 23 is a diagram for explaining the meanings of the terms-of-use (TOU) codes and the corresponding limit values. In FIG. 23, the terms-of-use code may be, e.g., one byte in length. The higher digit (X) of the TOU code indicates the target to which the terms of use is applied as shown in table 36. That is, higher digits of 0, 1, 2,... indicate that the TOU codes beginning with those digits are for the entire volume, application 1, application 2 and so on. The lower digit (Y) of the above mentioned terms-of-use code indicates the terms of use of the package 20 or the application 21 to which the code is set, and is directly followed by a corresponding limit value as shown in table 37 of FIG. 23. Specifically, the terms-of-use code (or TOU code) of 00H means, for example, that the volume 20 is usable freely after distribution. The value '31H' means, for example, that the application 3 to which the TOU code is set can be used by paying per unit of play duration. The lower digit of 2H or more means that the volume 20 or the application to which the TOU code is set can be used freely until the corresponding limit value are reached, which disables further use. As seen from the table, the use-limiting factors determined by the TOU codes whose lower digits are 2H to 5H are the current date and time, the expiration date and time, the amount of used period, and the access count, respectively.

Since the data of the distribution descriptor 23 can be set as described above, this provides both the providers and the users with more flexibility than conventional system can provide.

Again in FIG. 1, the DVD player 2 comprises a controller 100 for controlling the entire DVD player 2; data bus 102 connected with the not-shown CPU (central processing unit), not-shown ROM (read-only memory), RAM (random access memory) 101, and EEPROM (electrically erasable programmable ROM) 103 included in the controller 100; human interfaces (IFs) 110 including input devices such as a keyboard, a voice recognition device, a mouse, a remote controller, etc.; an IC card interface (IF) 120 for connecting the bus 102 with the ROM (not shown) in a IC card 5; a DVD driver 130 for reading out the data recorded on the DVD 3 and for demodulating and error-correcting the read data; a video and audio output IF 140 for receiving a MPEG 2 bit stream and outputting a video and audio output signals; a display device 146; a loudspeaker 148, and a communication IF 150 for communicating through the public telecommunication network 4. The IC card 5 stores a user's password PW_u and a user's secret key SK_u which corresponds to the user's public key PK_u mentioned in conjunction with the PK_u-encrypted AP-encrypting key (K_v) contained in the field 32 of the distribution descriptor 23 recorded in the burst cutting area of the DVD 3. The video and audio output IF 140 includes a MPEG 2 video decoder 142 and a MPEG 2 audio decoder 144.

As for obtaining the DVD 3, there may be some ways. If one is to buy a DVD 3, e.g., at some book store or through mail order, he or she has to have the PK_u-encrypted version of an application-encrypting key (K_v) recorded in the burst cutting area of the desired DVD 3 by notifying his or her public key PK_u which corresponds to his or her secret key SK_u stored in the IC card 5. If one is a member of a DVD distribution service, he or she can obtain a DVD with a PK_u-encrypted AP-encrypting key recorded without notifying the PK_u each time of obtaining because he or she must have notified the PK_u when he or she applied for the service.

In operation, the user first sets a desired DVD 3 in the DVD driver 130 of the DVD player 2, and issues a start command to the DVD player 2 through an appropriate human IF 110. In response to a receipt of the start command, the

controller 100 reads the volume control program 24 from the data area of the DVD 3 through the DVD driver 130 while loading the read program 24 into the RAM 101 of the controller 100, and then executes the volume control program 24.

FIG. 5 is a flow chart of the volume control program 24 for playing the application(s) 21 recorded on the DVD 3 according to the principle of the invention. In FIG. 5, the controller 100 first checks the AID1 field to see if the volume 20 contains a single application in step 500. If not, then the controller 100 displays the application IDs in the field 29 and prompts the user to select a desired one of the applications in step 502, and waits for the selection in step 504. If any application is selected in step 504, the controller 100 registers the application ID of the application as the application to be played in step 506 and proceeds to step 508 to check the field 35 of the terms-of-use (TOU) code plus limit value for the selected application to see if the field is empty. If so, the controller 100 proceeds to step 510 to read the volume limit field 34.

On the other hand, if the test result is YES in step 500, then the controller 100 registers the volume ID as the application to be played in step 512, and reads the volume limit value 34 in step 510.

If the step 510 is completed or the test result of step 508 is NO, then the controller 100 checks the terms-of-use (TOU) code to see if the lower digit of the TOU code is 0 in step 514. If so, then the controller 100 plays an application free of charge in step 650, and otherwise makes another check to see if the lower digit of the TOU code is 1 in step 516. If so, the controller 100 plays an application in a usage-sensitive charging in step 700, and otherwise (if the lower digit of the TOU code is 2 or more) play an application only when the software meter of a use-limiting factor is under a preset value in step 800. On completing any of the steps or processes 650 through 800, the controller 100 ends the program 24. Thus, the DVD player 2 plays a program specified by the user according to the terms of use determined by the TOU code which has been set to either the application package or the specified application.

The processes 650, 700 and 800 are executed interactively with an associated server 8. The servers 8 need various data for executing these processes, and store such data in the form of tables.

FIG. 6A is a diagram showing an exemplary structure of a volume data table stored in a server 8. In FIG. 6A, Each of the records of the volume data table 60 comprises volume ID (VID_v) and issue No. (NO_{v-i}) fields. The combination of VID_v and NO_{v-i} serves as the user ID of the user of the application package 20 or the DVD 3. For this reason, the table 60 has, for the members or subscribers of DVD distribution service or the like, personal data fields which contains, for example, a member ID, a name, an address, etc. Each record further comprises a volume minute meter field (VM-METER_{v-i}) containing a software meter of play duration in minute which is attached to (or associated with) the volume 20; a volume charge meter (VC-METER_{v-i}) containing a software charge meter which is attached to the volume 20; a limit value (LV_{v-i}) containing a limit value associated with the TOU code (e.g., the effective date and time, the allowable expiration date and time, the allowable access, etc.); a limit value meter (LV-METER_{v-i}); an application ID (AID_{v-i-a}) field containing the title of the application; an application minute meter (AM-METER_{v-i-a}) field containing a software meter of play duration in minute which is attached to the application of AID_{v-i-a}; an application charge meter (AC-METER_{v-i-a}) field for a software meter of play duration in minute which is attached to the application of AID_{v-i-a}; a limit value (LV_{v-i-a}) containing a limit value associated with the TOU code; and a limit value meter (LV-METER_{v-i}).

FIG. 6B is a diagram showing an exemplary structure of an application data table stored in a server 8. In FIG. 6B, the application data table 70 comprises the fields of, for example, an application code (ACODE_n), an application title (AID_n), a duration (D), a rate-per-access (RATE/ACCESS), an access count, a minute meter, etc. The duration is a period of time what it takes to play the application. The rate per access is a charge for a play of the whole application, which is used for informing the user of an expected play duration prior to a play. The rate per unit time is a charge for a unit time of play, which is used for the calculation of a charge for an actually timed play duration. The access count and minute meter fields contains the number of accesses to the application and a total amount of play time, which are not necessary for the present invention but will be used in statistical calculations for the analysis of, e.g., the tastes.

FIG. 7 is a diagram showing a structure of a server table 75 stored in the EEPROM 103 of the client 2. In FIG. 7, the fields of the table 75 comprises a server public key (PK_s), a server ID (SID_s), a server network address (SADD_s), etc. this table 75 is used for associating the server public key (PK_s) contained in the distribution descriptor 23 recorded in the burst cutting area of the DVD with the ID and the network address.

Play an Application Free of Charge

The initial routines of the processes 650, 700 and 800 are the same.

FIGs. 8A and 8B are flow charts of initial routines 80a and 80b which are executed interactively by the client 2 and the server 8, respectively, at the beginning of the processes 650, 700 and 800. In FIG. 8, the controller 100 of the client or the DVD 2, in step 82, sends a service request with the network address CADD_c of the client or DVD 2, the TOU code plus limit value, the volume ID (VID_v), the issue number (NO_{v-i}), the application ID (AID_{v-i-a}), and other data to the associated server 8 the ID of which is SID_s (SID_s is obtained from the table 75 in FIG. 7 by using the public key recorded on the DVD 3), and in step 92 waits for a response from the server (SID_s) 8. If there is a response from the server (SID_s), the client 2 proceeds to the next step through a circle with "A" therein.

On the other hand, in FIG. 8B, the server 8 of SID_s receives the message from the client 2, that is, the service request and the accompanying data and stores date in a predetermined location for subsequent use in step 84. Then, the server 8 searches the table 60 for a record which contains VID_v and NO_{v-1} in the volume ID and issue No. fields thereof, respectively in step 86. If the search is unsuccessful, then the server 8 adds the record for VID_v and NO_{v-1} and fills relevant fields with AID_{v-i-a} and a limit value, if any, in the table 60 in step 88, and proceeds to step 90. Also, if the search in step 86 is successful, the server 9 proceeds to step 90, where the server 8 selects a routine to execute next according to the value of the TOU code and enters the selected routine through a circle with "B" therein. In this case, if the TOU code = $x0H$ (x: an arbitrary HEX number, the letter H in the last position indicates that the preceding number is in hexadecimal), then a routine for playing an application free of charge is selected. If the TOU code = $x1H$, then a routine for playing an application in usage-sensitive charging is selected. If the TOU code $\geq x2H$, then a routine is selected which plays an application only if the software meter of a use-limiting factor is under a preset value.

FIG. 9 is a flow chart showing a procedure of a free play process shown as step 650 in FIG. 5, wherein connecting adjacent blocks by two flow lines indicates that each block is executed interactively by a client of $CADD_c$ and an associated server SID_s as shown in detail later. If the TOU code is 0 in step 514 of FIG. 5, then the server ($CADD_c$) enters the free play process 650 as shown in FIG. 9, and the client and the server (SID_s) execute the initial routine 80 in block 660. In block 670, they execute an expected play time informing routine, that is, displays an expected play time before playing an specified application. In block 680, they execute an application play and metered play time report routine. Since the routine 80 has been detailed in FIG. 8, the expected play time informing routine and the application play and metered play time report routine will be detailed in the following.

FIGs. 10A and 10B are flow charts jointly showing a procedure formed of exemplary expected play time informing routines 97a and 97b interactively executed by the client 2 and the associated server 8, respectively. In FIG. 10B, the server 8 retrieves the duration (D_n) of the application of AID_{v-i-a} from the table 70 in a well known manner in step 91. In the next step 92, the server 8 calculates an expected total amount of play time according to the value of the TOU code. Specifically, if the TOU code is $0xH$, then the client adds the duration (D_n) and the value of the $VM-METER_{v-1}$ field of the record identified by VID_v and NO_{v-1} in the table 60. If the TOU code is axH (a: the application number of the specified application in the volume), then the client adds the duration (D_n) and the value of the $AM-METER_{v-i-a}$ field of the record identified by VID_v , NO_{v-1} , and AID_{v-i-a} in the table 60. Then the server 8 sends the result to the client whose network address is $CADD_c$ in step 93, and ends the process.

On the other hand in FIG. 10A, the client 2 receives the incoming message or the value of the updated meter in step 94. In the next step 95, the value is displayed as the total amount of usage. Then the client 2 ends the process.

In updating a relevant meter, a predetermined value of duration has been used in the just described routines of FIG. 10 (a preset value metering system). This arrangement is suited mainly for such applications as it takes a constant time to play, and will not cause a problem unless the user discontinues the play. From this point of view, it is preferable to actually measure the playing time in metering (a timed value metering system). However, it is also noted that the preset value metering system is useful in informing the user of expected play time prior to an actual playing.

FIGs. 11A and 11B are flow charts jointly showing a procedure formed of exemplary timed play and metered usage report routines 675a and 675b interactively executed by the client and the server, respectively, for playing an application while timing the duration and displaying a timed play duration after the play. In the routine 675, the client and the server call a timed application-play subroutine for playing the application while timing the duration (play time) in step 200.

Then the server 8 proceeds to step 210, where the client updates a relevant meter according to the TOU code in the same manner as in step 92 of FIG. 10B. Specifically, if the TOU code is $0xH$, then the play time is added to the value of the $VM-METER_{v-1}$ field of the record identified by VID_v and NO_{v-1} in the table 60. If the TOU code is axH (a: the application number of the specified application in the volume), then the play time is added to the value of the $AM-METER_{v-i-a}$ field of the record identified by VID_v , NO_{v-1} , and AID_{v-i-a} in the table 60. Then the server 8 sends the play time and the value of the updated meter (i.e., the total amount of play time) to the client whose network address is $CADD_c$ in step 212, and ends the process.

On the other hand, the client 2, after step 200, make a test to see if there is a response from the server of SID_s in step 214. This step is repeated until the client 2 receives a call from the server 8, when the client 2 receives the incoming message or the value of the updated meter in step 216. In the next step 218, the client 2 displays the play time and the total amount of play time, and then ends the routine 675.

FIGs. 12A and 12B are flow charts jointly showing a procedure formed of exemplary timed application-play subroutines 205a and 205b executed by the client 2 and the server 8, respectively, for playing the application while timing the duration. The server 8 of SID_s waits for a notice in step 611 to see if the client has started playing the application. On the other hand, the client 2 of $CADD_c$ informs the server of a start of play in step 610 and immediately call an application play subroutine in step 612. This, causes the server 8 to start a timer in step 613, and waits for a notice of a stop of play from the client 2 in step 615. On completing the step 612, the client informs the server 8 of the stop of play in step 614. In response to this notice, the server 8 stops and reads the timer as the play time in step 617. After steps 614 and 617, the client and the server return.

Though the above described arrangement has used a timer of the server, it may be possible to use a timer of the client.

FIGs. 13A and 13B are flow charts jointly showing a procedure formed of alternative timed application-play subroutines 205ac and 205bc interactively executed by the client 2 and the server 8, respectively, in which timing of play time is achieved with a timer in the client. In the alternative subroutine 205a, the client 2 starts a timer in step 620, calls an application play routine in step 622, stops the timer in step 624, sends the play time to the server 8 in step 626, and then returns. On the other hand, the server 8, on entering the subroutine 295b, waits for a call from the client of CADD_c in step 621. If there is a call from the client 2, then the server 8 receives the play time in step 623 and then returns.

However, the arrangement of FIG. 13 has a possibility of permitting a mala fide user to manipulate the timer of the client 2. From this point of view, the arrangement shown in FIG. 12 is preferable to that of FIG. 13.

FIG. 14 is a flow chart of an exemplary application play subroutine called in steps 612 and 622 of FIGs. 12A and 13A, respectively, and executed by the controller 100.

Prior to the description of the flow chart, we define some notation concerning encryption and decryption. If encrypting X with a key EK according to an encrypting algorithm e yields Y, then it is expressed as:

$$e(EK, X) = Y.$$

Similarly, if decrypting Y with a key DK according to a decrypting algorithm d yields Z, then it is expressed as:

$$d(DK, Y) = Z.$$

Assuming that the algorithms e and d and the keys EK and DK correspond each other, that is, $d(DK, Y) = X$, it follows that

$$d(DK, e(EK, X)) = X.$$

Returning now to FIG. 14, the controller 100 reads the PK_v-encrypted application-encrypting (AP-encrypting) key (K_v) or e1(PK_v, K_v) from the filed 32 of the distribution descriptor 23 of the DVD in step 602. Here,

$$v = 1, 2, \dots, V,$$

where V is the number of kinds of the application package. This indicates that different application-encrypting keys K1 through K_v is assigned to respective kinds of applications, that is, volume VID1 through VID_v.

In the next step 604, the user secret key SK_u is read from the IC card 5. In the next step 606, the PK_v-encrypted AP-encrypting key e1(PK_v, K_v) is decrypted with the user secret key SK_u to obtain the application encrypting key K_v. Then in the next step 608, the K_v-encrypted application (AP), i.e., e(K_v, AP) which is recorded on the DVD 3 is decrypted with the obtained AP-encrypting key K_v to obtain $d(K_v, e(K_v, AP)) = AP$, while passing the obtained application data to the video and audio output IF 140. The obtained application data has the form of an MPEG 2 bit stream. The video and audio output IF 140 converts the MPEG 2 bit stream of the application data into video and audio output signals through MPEG 2 video and audio decoding. The video and audio output signals are applied to the display device 146 and the loudspeaker 148, respectively.

Play an Application in Usage-sensitive Charging system

FIG. 15 is a flow chart showing a procedure of a charged play process 700 shown as step 700 in FIG. 5, wherein connecting adjacent blocks by two flow lines indicates that each block is executed interactively by a client of CADD_c and an associated server of SID_s. In FIG. 15, the client 2 enters the process 700 via step 516 of FIG. 5 and proceeds to block 630, where the client 2 and the associated server 8 execute the initial routine 80. In the next block 640, the client 2 displays an expected charge and a total amount of charges received from the server 8, and let the user decide whether to play the desired application.

FIGs. 16A and 16B are flow charts jointly showing a procedure formed of exemplary expected charge informing routines 640a and 640b interactively executed by the client 2 and the associated server 8, respectively. The routines 640a and 640b are very similar to the routine 97 except that in the routine 640, the DURATION (D_n) or "play time" has been replaced with RATE PER ACCESS and "charge"; between steps 92a and 93a, there has been added a step 641 of the server generating and storing a pseudo random number R in a memory location R'; in step 93a, the server sends the pseudo random number R as well; between steps 94 and 95a there has been added a step 643 of the client storing the received pseudo random number R in a memory location R'' for subsequent use. The replacement of DURATION (D_n) with RATE PER ACCESS is achieved by accessing a RATE PER ACCESS field 74 instead of a DURATION field

73 in table 70. Further, in the routine 640 there have been added the following steps: in step 644 following the step 96a, the client 2 makes a check to see if the user decides to play the application; if not, the client 2 sends a quit message to the server of SADD_s in step 645, and ends the routine 640; on the other hand, in step 642 following the step 93a, the server 8 of SID_s waits for a call from the client 2 of CADD_c; on receiving a call from the client, the server makes another check in step 646 to see if what has been received is a quit message; if so, the client ends the routine 640; and if the user decided to play the application in step 644, which means that what the server has received is not a quit message but an encrypted credit card number as seen from the description below, then the client 2 and the server 8 proceed to the step 650 of FIG. 15.

In the next block 650, the server 8 obtains a user's credit card number (CCNOu) through the client 2 keeping the security of the card number as shown in FIGs. 17A and 17B. In step 647, the client 2 encrypts the credit card number of the user which has been input by the user through a human IF 110 with a key, i.e., the pseudo random number R which has been stored in a memory location R" in step 643 of FIG. 16A to obtain $e2(R, CCNOu)$. In the next step 648, the client 2 further encrypts $R + e2(R, CCNOu)$ with another key or a server public key read from the distribution descriptor 23 recorded in the burst cutting area of the DVD to obtain

$$e1(PK_s, R + e2(R, CCNOu)).$$

In the next step 649, the client 2 sends the encrypted data to the server 8. Through step 646 of FIG. 16B, the server proceeds to step 650, where the server 8 finds that what was received from the client CADD_c is encrypted data. In the next step 651, the server 8 reads a server secret key SK_s from an IC card 7. In the next step, the server 8 decrypts the received encrypted data with the server secret key SK_s as follows:

$$d1(SK_s, \text{encrypted data}) = d1(SK_s, e1(PK_s, R + e2(R, CCNOu))) = R + e2(R, CCNOu).$$

In step 653, the server 8 makes a check to see if the just obtained pseudo random number R coincides with the random number R which has been stored in a memory location R' of the server. If so, the server 8 sends an enable message to the client of CADD_c, and in step 655 decrypts $e2(R, CCNOu)$ with the pseudo random number R to obtain the user's credit card number CCNOu. On the other hand, in response to a reception of the enable message in step 657, the client 2 exits from the process. After step 655, the server also exits from the process. If the result is NO in step 653, then the server 8 sends a disable message to the client in step 656, and ends the process. In response to a reception of the disable message in step 657, then the client displays a message to this effect in step 658, and then ends the process.

After operation of block 650, the client 2 waits, in step 663, for a report from the server on whether the credit card for the transmitted card number (CCNOu) is valid or not, while the server 8 refers to the credit company associated with the card number in step 661 to see if the credit card is valid. If not, the server 8 informs the client 2 of the invalidity of the credit card in step 662, and ends the process. If the card is valid in step 661, the server 8 informs the client of the validity in step 667. If the client 2 receives a report from the server in step 663, the client makes another check in step 664 to see if the report indicates the validity of the card. If not, the client displays a message to indicate the invalidity in step 665, and ends the process. If the report indicates the validity in step 664, which means the completion of step 667, then the client 2 and the server 8 proceed to the next block 670.

In step 670, the client 2 and the server 8 execute timed play and metered charge report routine. FIGs. 18A and 18B are flow charts jointly showing a procedure formed of routines 675ac and 675bc interactively executed for playing an application while timing the duration and displaying a charge and a total amount of charges after the play. In FIG. 18, the routines 675ac and 675bc are identical to the routine 675a and 675b in FIGs. 11A and 11B except that "time" has been replaced with "charge", and accordingly VM-METER and AM-METER have been replaced with VC-METER and AC-METER.

The operation, in the client 2, of playing an application on usage-sensitive charging is completed by block 675 of FIG. 15 or step 218a of FIG. 18A. After step 212a, the server 8 charges the play to the credit card number CCNOu obtained in step 655 of FIG. 17B in step 680. This completes the whole of the charged application play process of FIG. 15.

In this process, only information on charge is given to the user. It is very easy to provide information on both time and charge by adding steps 91 through 93 and 95 to the routines 640b and 640a, and by adding steps 210 and 218 to the routines 675bc and 675ac.

As described above, expected time and/or charge are (is) displayed before playing a user specified application. This is helpful for the user to decide whether to play the application. Additionally, charging is done based on the actually timed play duration. This makes the charging reasonable.

In the above description, the arrangement is such that the user has to input his or her credit card number CCNOu each time he or she wants to play an application. However, instead of doing this, the credit card number CCNOu may be stored in non-volatile memory or EEPROM 103 in a PW_u-encrypted form. In this case, CCNOu is obtained by decrypting PW_u-encrypted CCNOu (e.g., $e(PW_u, CCNOu)$) with a password entered by the user. That is, $d(\text{entered password}, e(PW_u, CCNOu)) = CCNOu$.

Permit the Play Within a Preset Limit

FIG. 19 is a flow chart showing a procedure interactively executed by the client 2 and the server 8 in the operation block 800 of FIG. 5, wherein blocks connected with two flow lines indicates that operation of the blocks is done by the two elements 2 and 8. In this case, it is assumed that a preset limit is recorded in or on the application package and is transmitted from client 2 to server each time of play. On entering the process 800 via step 516 of FIG. 5, the client 2 proceeds to step 801, where the client 2 and the server 8 executes the initial routines 80. It is noted that in routine 80b, if there is a record for VID_v and $NO_{v,i}$, then the limit value ($LV_{v,i}$) field of the table 60 of FIG. 6A contains the limit value transmitted from the client 2, otherwise, the received limit value is stored in the $LV_{v,i}$ field when the record for VID_v and $NO_{v,i}$ is added in step 88.

In step 810, the server 8 makes a check if a meter associated with the TOU code received from the client 2 is under the limit value. This check is made by comparing an LV field and LV-meter field associated with the TOU code in table 60. If the value of the LV-meter is equal to or greater than the LV field value, then the server returns an over limit message to the client 2 in step 820. If not, the server 8 returns an underlimit message to the client 2 in step 822, and proceeds to step 828. If the client 2 receives the overlimit message in step 824, then the client 2 displays a message to this effect. If not, the client 2 proceeds to the step 828.

Since the expected play time informing routines 97a and 97b and the application play subroutine 600 has been described above, the description of steps 828 and 830 are omitted.

According to this feature of the invention, it is possible to limit the use of charged information. This feature is especially useful in case when a user who have paid in advance for the use of the application package is permitted to use the application package within a limit value.

Though it has been assumed that the limit values are included in the application package, the limit values may be kept in the servers of the provider or distributor from the beginning. In this case, the limit values are fixed. However, if limit values are permitted to be set and recorded in the application package at the time of distribution or sales, the limit values are advantageously set according to an amount paid.

As is apparent from the foregoing, as a limit value, any use-limiting factors will do that can be measured in quantity. Such limit values are, for example, the effective date and time, the allowable expiration date and time, the maximum amount of play time, the allowable access count.

It is also possible to combine this feature with a charged application play feature. That is, an arrangement may be such that the user is permitted to use an application package on usage-sensitive charging only if the value of an LV-meter associated with the TOU is under the value of the corresponding LV or the value recorded in a field 33 or 34 of the distribution descriptor 23.

Modification I

In the above embodiment, applications, if more than one, in one volume are encrypted by an identical application encrypting key K_v . However, the applications APa in one volume may be encrypted with respective AP-encrypting keys K_a , where a lower case "a" following AP and K is a serial number assigned to each application ID. In this case, each of the AP-encrypting keys K_a are encrypted with the user public key PK_u , and stored in the PK_u -encrypted AP-encrypting key (K_a) fields 32a in the distribution descriptor 23.

Modification II

It has been assumed that the user of the DVD 3 is limited to the purchaser thereof who have had the PK_u -encrypted AP-encrypting key (K_v) recorded on the DVD 3. However, the system may be so arranged that predetermined people, e.g., family members FM_1, FM_2, \dots, FM_N of the purchaser can use the DVD (N is the number of the family members). One of the ways to realize this is to encrypt the AP-encrypting key K_v with a public key PK_{u-n} of each member FM_n ($n = 1, 2, \dots, N$) to obtain $e1(PK_{u-1}, K_v), e1(PK_{u-2}, K_v), \dots, e1(PK_{u-n}, K_v)$ and to record them in the PK_{u-n} -encrypted AP-encrypting key $e1(PK_{u-n}, K_v)$ fields 32 of the distribution descriptor 23 at the time of purchase of the DVD.

Modification III: K_v Retrieval From Server

In the above description, the AP-encrypting key K_v has been recorded in a PK_u -encrypted form on the DVD 3. However, the AP-encrypting key K_v may be managed by the server 8 and transmitted to the client or the DVD player 2 in response to a request issued from the DVD player 2 each time of use of the DVD 3. In this case, there is no need of providing the distribution descriptor 23 with the PK_u -encrypted AP-encrypting key field 32. Instead each of the servers has to store an AP-encrypting key table (or K_v table) and a PK_u table (shown in FIGs. 20A and 20B) in the hard disc. As shown in FIG. 20A, the K_v table a volume ID (VID_v) field (as the entry of record) and an AP-encrypting key (K_v) field in

each record. In FIG. 20B, each record of the PK_u table comprises a volume ID (VID_v) field (as the entry of record), a volume issue number ($NO_{v,i}$) field and a PK_u field (Successive same values in the first field are shown by showing only the first appearing one). Further, the process (or step) 610 of obtaining the AP-encrypting key K_v , that is, a group of the steps 602, 604 and 606 in the application play routine 600, has to be replaced with a process of FIG. 20C.

5 FIG. 20C is a flow chart of a process in which the client DVD player 2 obtains the application encrypting key K_v from the server 8. In step 616, the server 8 retrieves a key K_v from the K_v table by using VID_v . In the next step 618, the key K_v is encrypted with an arbitrary number used only in the current process, e.g., a pseudo random number R to obtain $e2(R, K_v)$. In the next step 620, the server 8 retrieves a key PK_u from the PK_u table by reading the PK_u field of the record which contains VID_v and $NO_{v,i}$ in the VID_v and $NO_{v,i}$ fields, respectively. In the next step 622, $R + e2(R, K_v)$ is encrypted with the retrieved key PK_u to obtain a double encrypted AP-encrypting key

$$e1(PK_u, R + e2(R, K_v)),$$

which is returned to the client with a client network address $CADD_c$ in the next step 624.

On the other hand, the controller 100 of the client 2 waits for a response from the server 8 of SID_s in step 626. If there is any response from the server 8 of SID_s in step 626, then the client DVD 3 receives the data $e1(PK_u, R + e2(R, K_v))$ from the server 8 in step 628. In the next step 630, the received data is decrypted with the user secret key SK_u read from the IC card 5. Specifically, the following calculation is done.

$$d1(SK_u, e1(PK_u, R + e2(R, K_v))) \Rightarrow R + e2(R, K_v)$$

In the next step 632, $e2(R, K_v)$ is decrypted with the obtained pseudo random number R . Specifically, the following calculation is done.

20
$$d2(R, e2(R, K_v)) \Rightarrow K_v$$

Thereafter, the controller 100 proceeds to the step 608 of FIG. 14.

In this modification, the applications AP_a in one volume may be encrypted with respective AP-encrypting keys K_a . In this case, the K_v table has to be replaced with K_a table in which each record comprises an application ID (AID_a) field and an AP-encrypting key (K_a) field. Further in step 612, the controller 100 of the DVD player 2 has to also send the application ID of the application to be played to the server.

Also in this modification, the system may be, again, so arranged that predetermined people, e.g., family members FM_1, FM_2, \dots, FM_N of the purchaser can use the DVD (N is the number of the family members). In this case, for each member FMn ($n = 1, 2, \dots, N$), the server 8 has to use the member's own public key PK_{u-n} in encrypting the AP-encrypting key K_v . One way to realize this is to issue a volume issue number NO_{v-i-n} to each member FMn at the time of sales of the DVD, provide the non-volatile memory (not shown) of the DVD player 2 with a table for associating the user's password PWn with the volume issue number NO_{v-i-n} , send the volume issue number (NO_{v-i-n}) associated with the user's password in step 612, and use not the PK_u table but a PK_{u-n} table in which each of the records has the following fields:

$VID_v, NO_{v-i-n}, PK_{u-n}$.

35 Another way is to issue and record not only a volume issue number $NO_{v,i}$ but also family member numbers $FMNn$ for all members at the time of sales of the DVD, provide the non-volatile memory (not shown) of the DVD player 2 with a table for associating the user's password PWn with the corresponding family member number $FMNn$, send the volume issue number ($NO_{v,i}$) and the family member number $FMNn$ associated with the user's password in step 612, and use another PK_{u-n} table in which each of the records has the following fields:

40 $VID_v, NO_{v,i}, FMNn, PK_{u-n}$.

In the process of FIG. 20C, the server 8 may be authenticated by means of a public-key cryptosystem using a pair of server secret and public keys (SK_s, PK_s). In this case, the server 8 signs the double-encrypted AP-encrypting key

$$e1(PK_u, R + e2(R, K_v))$$

with a signing key or the server secret key SK_s after step 622. While the client or DVD player 2 tests the signature by the server 8 with a test key or the server public key PK_s contained in the PK_s field 31 of the distribution descriptor 23 recorded in the burst cutting area of the DVD 2 before step 630.

However, even if just described authentication of the server 8 is omitted, an attacker will never go to any greater length than a steal of TOU code plus limit value, a volume ID VID_v , a volume issue number $NO_{v,i}$, and the client network address $CADD_c$. This is not a serious problem.

50 In the process of FIG. 20C, a pseudo random number R has been used as a pseudo variable which takes a different value each time of execution of the process. However, as the pseudo variable, anything will do if the result of encryption with it takes a different value each time of execution of the process.

Modification IV

55

In the first illustrative embodiment, the decryption of application is achieved by software. For this purpose, the controller 100 has to read the user secret key SK_u from the IC card 5 through the bus 102, which leaves the possibility of permitting a breaker to easily steal the user secret key SK_u through the bus 102. In order to prevent this, the process

achieved by the steps 604 through 608 may be realized by hardware as shown in FIG. 21, which is a block diagram of an exemplary decipherer-built-in IC card IF. In FIG. 21, the decipherer-built-in IC card IF 120a comprises an IC card receptacle 121 and a printed wiring board 122 extending from and fixed with the receptacle 121. An IC 123 is mounted on the printed wiring board 122. The IC 123 comprises a memory IF 125 which usually connects the memory of the IC card 5 with the bus 102 and, in response to an instruction from the controller 100, reads and passes the key SK_u to the next stage; a K_v decoder 126 for receiving the key SK_u and encrypting $e1(PK_u, K_v)$ with the key SK_u to yield K_v ; and an AP decoder 127 for receiving the key K_v and encrypting $e(K_v, AP)$ to yield application data (AP). The printed wiring board 122 portion may be preferably molded together with the IC card receptacle 121 portion so as to make the whole a single body. By doing this, leaking of the user secret key SK_u can be prevented.

This modification can be also applied to a system 1 using the cryptosystem of FIG. 20C. In this case, the K_v decoder 126 of FIG. 21 has to be replaced with a K_v decoder 126a as shown in FIG. 22. In FIG. 22, the K_v decoder 126a decrypts the input data, $e1(PK_u, R + e2(R, K_v))$, from the bus 102 by using the user secret key SK_u passed by the memory IF 125 to obtain $R + e2(R, K_v)$, while decrypting the obtained data $e2(R, K_v)$ with the obtained random number R and outputting the key K_v .

Embodiment II

FIG. 24 is a block diagram showing an arrangement of a system capable of playing a distributed application package, e.g., a DVD on the terms of use of the DVD without communicating with any server according to a second illustrative embodiment of the invention. In FIG. 24, the system 1a is identical to the client 2 of FIG. 1 except that the communication IF 150 has been eliminated because of no need of communication with a server and the controller 100 has been replaced with a controller 100a. In the controller 100a, a not-shown ROM for storing a control program as described later and the EEPROM 103 have been also replaced with a new ROM (not shown) and an EEPROM 103a. In order to play a role of the server 8, the system 1a has to have table 60 of FIG. 6A in any non-volatile memory, e.g., the EEPROM 103a and an application duration (play time) for each application as defined in table 70 of FIG. 6B has to be included in the control data of each application package.

FIG. 25 schematically shows an exemplary control program executed by the controller 100a shown in FIG. 24. The control program of FIG. 25 is also identical to that of FIG. 5 except that the decision step 516 and the step 700 has been eliminated because the limit-attached play mode is not supported by the system 1a in this embodiment, and the steps 650 and 800 are replaced with steps 650a and 800a. Accordingly, operation after step 514 will be described in the following.

If the lower digit of the terms-of-use (TOU) code is 0 in the decision step 514, then in step 650a the controller 100a plays, in the free play mode, the application stored in the selected application in step 506 or 512 and ends the operation. It should be noted that since the system 1a does not have the charged play mode, the lower digit of the TOU code is defined as follows.

Higher digit of terms-of-use code (Hexadecimal)	Corresponding limit value	Play mode
0	None	Free play mode
2	Effective date and time	Limit-attached play mode
3	Allowable expiration date and time	
4	Maximum amount of used period	
5	Allowable access count	
:	:	
:	:	

Accordingly, if the lower digit of the TOU code is not 0 in the decision step 514, then in step 800a the controller 100a plays, in the limit-attached play mode, the application stored in the selected application in step 506 or 512 and ends the operation.

FIGs. 26 and 27 show an operation of a free play mode shown in step 650a of FIG. 25 in a detailed form and a further detailed form, respectively. In FIG. 26, the controller 100a executes an initial routine 80a in step 660a, in step 670a executes an expected play time informing routine, and in step 680a executes an application play and metered play time report routine.

As shown in FIG. 27, in the initial routine 80c, the controller 100a searches the table 60 for a record which contains VID_v and $NO_{v,i}$ in the volume ID and issue No. fields thereof, respectively in step 86. If the search is unsuccessful, then the controller 100a adds the record for VID_v and $NO_{v,i}$ and fills relevant fields with $AID_{v,i-a}$ and a limit value, if any, in the table 60 in step 88, and proceeds to step 90. Also, if the search in step 86 is successful, the server 9 proceeds to step 90, where the controller 100a selects a routine to execute next according to the value of the TOU code and enters the selected routine. In this case, if the TOU code = x0H (x: an arbitrary HEX number, the letter H in the last position indicates that the preceding number is in hexadecimal), then a routine for playing an application free of charge is selected. If the TOU code \geq x1H, then a routine is selected which plays an application only if the software meter of a use-limiting factor is under a preset value.

The expected play time informing routine 670a is identical to the routines 97 (FIG. 10) minus communication steps 93 and 94, comprising the above described steps 91, 92 and 95. Similarly, it is seen from FIGs. 11 and 13A that the above described steps 620, 622, 624, 210 and 218 are executed in this order in the timed play and metered usage report routine 680a. In this way, the system 1a permits the user to play the application stored in the selected application (steps 506 and 512 of FIG. 25) free of charge.

FIG. 28 is a flow chart showing an operation of a limit-attached play mode shown in step 800a of FIG. 25. Since this operation is very similar to that of FIG. 19, only the flow is briefly described, omitting the details of each step. In FIG. 28, controller 100a first makes a check if a meter associated with the TOU code has reached the limit value obtained with the TOU code. If so, then the server returns an overlimit message to controller 100a in step 820. Otherwise, the controller 100a proceeds to the expected play time informing routine 828a (= 670a), where the controller 100a executes the above described steps 91, 92 and 95, and then calls the application play subroutine 600 in step 830, thereby completing the operation. Since the application play subroutine 600 has been detailed above, further description is omitted. In this way, the system 1a permits the user to play the application stored in the selected application (steps 506 and 512 of FIG. 25) only if the limit value associated with the TOU code assigned to the volume or the user-specified application has not been reached.

According to the second embodiment, the system 1a can operate in either of the free play mode and the limit-attached play mode without the need of communication with a server. For this, the system 1a may be made portable.

Modifications

In the above description, the illustrative embodiment has been described in conjunction with the DVD. The same discussion can be applied to such package media as permit write once or more.

Further, the present invention is also applicable to application packages distributed via transmission media. In this case, the distributed application packages are stored in a bulk storage in the user's device. An application package comprises one or more application and application control data, that is, an application descriptor and distribution descriptor. One volume is stored as a file. Since a plurality of application package may be stored in a single storage, each application package does not have to contain a control program. One control program, which may be distributed via either package or transmission media, is enough for one user device. The folder or directory in which the application packages are stored is set for a user specified one in the control program when the control program is installed. The data to be recorded in the distribution descriptor is included in the application package by the provider according to the information given by the user.

As described above, one who is permitted to use an application package is limited to an owner of the IC card which stores a user secret key SK_u corresponding to the user public key PK_u used for encryption of the AP-encrypting key K_v in the application package. For this, even if someone has unjustly obtained an application package, for example, by copying the whole volume from the DVD on which the volume is recorded, he or she can not use it without the IC card of the owner of the DVD. Thus the inventive system can prevent unjust use of an application package (DVD in this case) by any other person than the regular owner of the application package.

Also, the inventive system is so arranged that most part of the application package is recorded by pressing in manufacturing process of the DVDs, whereas at least a part of the volume control data (i.e., the distribution descriptor) can be determined at the time of, e.g., distribution of each of the DVDs after the manufacturing process. This makes the system flexible because control data can be easily changed without changing the stamper.

In the initial routines 80a and 80b in FIG. 8A and 8B, the data transmitted with the service request may be encrypted in the same manner as in case of the transmission of user's credit card number shown in FIG. 17. However, in case of the initial routines, there are a plurality of data. These data may be encrypted in the following way.

If the data to be encrypted are $D1, D2, \dots$ then they are first encrypted with a key R as follows:

$e2(R, D1), e2(R, D2), \dots$

Then further encryption is made with a server public key PK_s as follows:

$e1(PK_s, R + e2(R, D1) + e2(R, D2), \dots)$.

In the process of FIG. 17, the user may be authenticated by means of a public-key cryptosystem using a pair of

user secret and public keys (SK_u , PK_u). In this case, the client 2 signs the double-encrypted credit card number $e_1(PK_u, R + e_2(R, CCNO_u))$

with a signing key or the user secret key SK_u after step 648. While the server tests the signature by the client 2 with a test key or the user public key PK_u before step 650.

5 Instead of storing a single server public key in the distribution descriptor 23, a plurality of server public keys or all the server public keys may be recorded. By doing this, it is possible, for example, to setting a different charge depending on the server public key which the user have selected by appropriately combining the tables 70 and 75.

Also, application packages with an identical volume ID can have different server public keys recorded. A plurality of toll center may be advantageously provided for application packages of the same title.

10 In order to prevent any use of IC card by other person than the owner of the IC card, it is possible to add, before the Sku reading step 604, the steps of prompting the user to enter a password through a human IF 110 and proceeding to step 604 only if the entered password coincides with the user password PW_u stored in the IC card.

Though the IC card 5 is used in the above embodiment, the IC card IF 120 may be replaced with a magnetic card reader to permitting the use of the magnetic card. Alternatively, the arrangement may be such that the user enters his or her password each time the user uses the DVD.

15 Instead of storing the user secret key SK_u in the IC card 5, the key Sku may be stored in non-volatile memory in a PW_u -encrypted form. In this case, the key SK_u is obtained by decrypting PW_u -encrypted SK_u with a password entered by the user.

The discussion of three preceding paragraphs are applied to the IC card used for storing the server secret key in the server. However, in this case the user has to be taken as the administrator of the toll server.

20 Many widely different embodiments of the present invention may be constructed without departing from the spirit and scope of the present invention. It should be understood that the present invention is not limited to the specific embodiment described in the specification, except as defined in the appended claims.

A system for permitting only an authentic user to play a desired application contained in a distributed application package in one of predetermined operation, e.g., free play mode, charged mode, limit-attached play mode, etc. The system comprises a client for playing an application under the control of a server connected with the client through a communication network. The application package (the volume) includes a distribution descriptor which contains mode codes assigned to the volume and the applications of the volume. The data of distribution descriptor is decided and stored in the descriptor at the time of distribution of the volume. This feature makes the system flexible. There is also disclosed a system operatable without communicating with a server.

Claims

- 35 1. An application package for use in a system for playing an application contained in the application package (the volume), the application package comprising:

application data for at least one application; and
volume control data for use in controlling said system, wherein said volume control data at least comprises:
a volume ID for identifying the kind of said application package (said volume);
40 an issue number assigned in order of issue to each of the volumes of said kind; and
application IDs each assigned to one of said at least one application contained in said volume, and wherein:
at least a part of said volume control data is to be added to said volume after the creation of said volume; and
said at least a part of said volume control data includes said issue number.

- 45 2. An application package as defined in claim 1, wherein:

said application data has been encrypted with an encrypting key; and
said at least a part of said volume control data includes a user's public key-encrypted version of said encrypting key used.

- 50 3. An application package as defined in claim 1, wherein said at least a part of said volume control data includes mode codes which are assigned to said volume or said at least one application and each indicate a play mode associated with one of said volume or said at least one application to which the mode code is assigned.

- 55 4. A package media on which an application package as defined in claim 1 has been recorded.

5. A package media of a write-once type on which an application package as defined in claim 1 has been recorded.

EP 0 840 194 A2

6. A package media on which an application package as defined in claim 1 has been recorded wherein said at least a part of said volume control data is recorded in an area different from data area where said application data is recorded on the package media.
- 5 7. A method for sending data with a raised security from a first device to a second device through a public telecommunication network, comprising the steps of:
- in said second device,
- 10 generating a pseudo random number;
transmitting said pseudo random number to said first device;
- in said first device,
- 15 encrypting said data with said transmitted pseudo random number into encrypted data;
encrypting concatenated data consisting of said pseudo random number and said encrypted data with a public key of said second device into double-encrypted data;
sending said double-encrypted data to said second device; in said second device,
20 decrypting said double-encrypted data with a secret key of said second device which corresponds to said public key into decrypted data consisting of a decrypted random number portion and another decrypted portion; and
decrypting said another decrypted portion with said transmitted random number to obtain said data.
8. A method for sending a plurality of pieces of data with a raised security from a first device to a second device through a public telecommunication network, comprising the steps of:
- 25 in said second device,
- generating a pseudo random number;
30 transmitting said pseudo random number to said first device;
- in said first device,
- 35 encrypting each of said pieces of data with said transmitted pseudo random number into an encrypted piece of data;
encrypting concatenated data consisting of said pseudo random number and said encrypted pieces of data with a public key of said second device into double-encrypted data;
sending said double-encrypted data to said second device; in said second device,
40 decrypting said double-encrypted data with a secret key of said second device which corresponds to said public key into decrypted data consisting of a decrypted random number portion and said plurality of decrypted data portions; and
decrypting each of said decrypted portions with said transmitted random number to obtain said pieces of data.
- 45 9. A method as defined in claim 7 or 8, further comprising the steps, executed after said step of decrypting said double-encrypted data, of:
- proceeding to a next step only if said decrypted random number portion coincides with said transmitted pseudo random number; and
50 said second device informing said first device of a failure in decryption if said decrypted random number portion does not coincide with said transmitted pseudo random number.
10. In a system provided with means for playing an application contained in an application package, a method for permitting a user to play an encrypting key-encrypted application contained in a distributed application package which further contains, as volume control data, a user's public key-encrypted encrypting key so encrypted as to be able to be decrypted with a secret key of the user into said encrypting key, the method comprising the steps of:
- 55 reading said user's public key-encrypted encrypting key from said distributed application package (said vol-

ume);

obtaining said secret key;

decrypting said user's public key-encrypted encrypting key with said secret key to obtain said encrypting key;
and

decrypting said encrypting key-encrypted application with said obtained encrypting key into application data
while passing said application data to said means for playing an application.

11. In a system comprising a client provided with means for playing an application contained in an application package and a server connected with the client through a communication network, a method for permitting a user to play one of encrypting key-encrypted applications contained in a distributed application package which further contains, as volume control data, a volume ID for identifying the kind of said distributed application package (said volume), an issue number issued to each volume of the kind in an issued order and application IDs, the method comprising the steps of:

said client reading said volume ID, said issue number and an application ID for said one of encrypting key-encrypted applications (said encrypting key-encrypted application) from said volume and sending to said server;

in said server,

retrieving said encrypting key by using said volume ID;

retrieving a public key of said user by using said volume ID and said issue number;

generating a pseudo random number;

double-encrypting said encrypting key with said pseudo random number and said public key into a double encrypted data;

sending said double-encrypted data to said client; in said client,

obtaining a secret key of said user which corresponds to said public key;

obtaining said encrypting key by decrypting said double-encrypted data with said secret key;

decrypting said encrypting key-encrypted application with said obtained encrypting key into application data while passing said application data to said means for playing an application.

12. A method as defined in claim 10 or 11, wherein said means for obtaining a secret key comprises means for reading said secret key from a portable memory of said user.

13. A method as defined in claim 12, wherein said portable memory is an IC card.

14. In a system comprising a client provided with means for playing an application package and a server connected with the client through a communication network for controlling the client, the application package (the volume) containing, as volume control data, a volume ID and an issue number issued to each of the volumes of said volume ID in an issued order, a method for controlling the amount of play time comprising the steps of:

said client sending said volume ID and said issue number to said server;

said server retrieving an expected play time associated with said volume ID and said issue number; and

said server adding said expected play time to the value of a total play time associated with said volume ID and said issue number.

15. In a system comprising a client provided with means for playing an application contained in an application package and a server connected with the client through a communication network for controlling the client, the application package (the volume) containing, as volume control data, a volume ID, an issue number issued to each of the volumes of said volume ID in an issued order and an application ID for the application, a method for controlling the amount of play time comprising the steps of:

said client sending said volume ID, said issue number and said application ID to said server;

said server retrieving an expected play time associated with said volume ID, said issue number and said application ID; and

said server adding said expected play time to the value of a total play time associated with said volume ID and said issue number.

16. In a system comprising a client provided with means for playing an application contained in an application package and a server connected with the client through a communication network for controlling the client, the application package (the volume) containing, as volume control data, a volume ID and an issue number issued to each of the volumes of said volume ID in an issued order, a method for controlling the amount of play time comprising the steps of:

said client and said server interactively measuring, as a measured play time, a play time of said application;
and
said server adding said measured play time to the value of a total play time associated with said volume ID and said issue number.

17. A method as defined in claim 16, wherein said step of measuring a play time comprises the step of using a timer of said server.

18. A method as defined in claim 16, wherein said step of measuring a play time comprises the step of using a timer of said client.

19. In a system comprising a client for playing an application package and a server connected with the client through a communication network wherein the application package (the volume) comprises application data and control data and at least a part of the control data has been added to the volume after the creation of said volume, a method for sending desired data from one side of said client and said server to the other side, the method comprising the steps of:

including a secret key of said other side in said at least a part of said control data;

in said other side,

generating a pseudo random number;
transmitting said pseudo random number to said one side;

in said one side,

encrypting said desired data with said transmitted pseudo random number into encrypted data;
encrypting concatenated data consisting of said pseudo random number and said encrypted data with said public key of said other side into double-encrypted data;
sending said double-encrypted data to said other side;

in said other side,

decrypting said double-encrypted data with a secret key of said other side which corresponds to said public key into decrypted data consisting of a decrypted random number portion and another decrypted portion; and
decrypting said another decrypted portion with said transmitted random number to obtain said desired data.

20. A method as defined in claim 19, wherein said generating a pseudo random number includes storing said pseudo random number in memory, and wherein the method further comprises the step, executed prior to said decrypting said another decrypted portion, of:

in response to a determination that said decrypted random number portion does not coincide with said pseudo random number stored in said means for storing said pseudo random number stored in said memory, informing said one side of a failure in decryption instead of passing the control to next means.

21. In a system comprising a client provided with means for playing an application contained in an application package and a server connected with the client through a communication network, a method for permitting a user to play an application contained in a distributed application package which further contains, as volume control data, a volume ID for identifying the kind of said distributed application package (said volume), an issue number issued to each volume of the kind in an issued order, and an application ID for said application, the method comprising the steps of:

proceeding to a next step only if the value of a meter field associated with said volume ID, said issue number and said application ID is under the value of a limit value field associated with said volume ID, said issue number and said application ID in a volume data table; and
displaying a message informing an overlimit on a display device of said client and quit the operation otherwise.

- 5 22. In a system comprising a client provided with means for playing an application contained in an application package and a server connected with the client through a communication network, a method for permitting a user to play an application contained in a distributed application package which further contains, as volume control data, a volume ID for identifying the kind of said distributed application package (said volume), an issue number issued to each volume of the kind in an issued order, an application ID for said application and a limit value for limiting the play of said application, the method comprising the steps of:

10 proceeding to a next step only if the value of a meter field associated with said volume ID, said issue number and said application ID in a volume data table is under said limit value; and
15 displaying a message informing an overlimit on a display device of said client and quit the operation otherwise.

23. A method as defined in claim 21, wherein said limit value is one of effective date and time, allowable expiration date and time, a maximum amount of play time, and an allowable access count.

- 20 24. A method as defined in any of claims 11, 15 and 16, wherein said step of said client sending to said server comprises the steps of:

25 said client encrypting at least one of said volume ID, said issue number and said application ID into encrypted data; and
said server decrypting said encrypted data.

25. A system for sending data with a raised security from a first device to a second device through a public telecommunication network, comprising:

30 means provided in said second device for generating a pseudo random number;
means provided in said second device for transmitting said pseudo random number to said first device;
means provided in said first device for encrypting said data with said transmitted pseudo random number into an encrypted data;
35 means provided in said first device for encrypting concatenated data consisting of said pseudo random number and said encrypted data with a public key of said second device into double-encrypted data;
means provided in said first device for sending said double-encrypted data to said second device;
means provided in said second device for decrypting said double-encrypted data with a secret key of said second device which corresponds to said public key into decrypted data consisting of a decrypted random number portion and another decrypted portion; and
40 means provided in said second device for decrypting said another decrypted portion with said transmitted random number to obtain said data.

26. A system for sending a plurality of pieces of data with a raised security from a first device to a second device through a public telecommunication network, comprising:

45 means provided in said second device for generating a pseudo random number;
means provided in said second device for transmitting said pseudo random number to said first device;
means provided in said first device for encrypting each of said pieces of data with said transmitted pseudo random number into an encrypted piece of data;
50 means provided in said first device for encrypting concatenated data consisting of said pseudo random number and said encrypted pieces of data with a public key of said second device into double-encrypted data;
means provided in said first device for sending said double-encrypted data to said second device;
means provided in said second device for decrypting said double-encrypted data with a secret key of said second device which corresponds to said public key into decrypted data consisting of a decrypted random number portion and said plurality of decrypted data portions; and
55 means provided in said second device for decrypting each of said decrypted portions with said transmitted random number to obtain said pieces of data.

27. A system as defined in claim 25 or 26, further comprising:

5 means, provided in said second device, activated prior to decrypting each of said decrypted portions and responsive to a determination that said decrypted random number portion does not coincide with said transmitted pseudo random number, for informing said first device of a failure in decryption instead of passing the control to next means.

28. A system for playing an encrypting key-encrypted application contained in a distributed application package which further contains, as volume control data, a user's public key-encrypted encrypting key so encrypted as to be able
10 to be decrypted with a secret key of the user into said encrypting key, the system comprising:

means for reading said user's public key-encrypted encrypting key from said distributed application package (said volume);
means for obtaining said secret key;
15 means for decrypting said user's public key-encrypted encrypting key with said secret key to obtain said encrypting key;
means for decrypting said encrypting key-encrypted application with said obtained encrypting key to provide application data; and
means for using said application data for playing.

29. A system for permitting a user to play an encrypting key-encrypted application contained in a distributed application package which further contains, as volume control data, a volume ID for identifying the kind of said distributed application package (said volume), an issue number issued to each volume of the kind in an issued order and application IDs, the system comprising:

25 a client for playing an application by using application data; and
a server for controlling said client through a communication network, wherein said client comprises:
means for reading and sending said volume ID, said issue number and an application ID for said one of encrypting key-encrypted applications (said encrypting key-encrypted application) from said volume to said
30 server, said server comprises:

means for retrieving said encrypting key by using said volume ID;
means for retrieving a public key of said user by using said volume ID and said issue number;
means for generating a pseudo random number;
35 means for double-encrypting said encrypting key with said pseudo random number and said public key into a double encrypted data; and
means for sending said double-encrypted data to said client, and said client comprises:
means for obtaining a secret key of said user which corresponds to said public key;
means for obtaining said encrypting key by decrypting said double-encrypted data with said secret key;
40 means for decrypting said encrypting key-encrypted application with said obtained encrypting key to provide application data; and
means for using said application data for playing.

30. A system as defined in claim 28 or 29, wherein said means for obtaining a secret key comprises means for reading
45 said secret key from a portable memory of said user.

31. A system as defined in claim 30, wherein said portable memory is an IC card.

32. A system for permitting a user to play a distributed application package which further contains, as volume control data, a volume ID for identifying the kind of said distributed application package (said volume) and an issue number
50 issued to each volume of the kind in an issued order, the system comprising:

a client for playing said distributed application package; and
a server for controlling said client through a communication network, wherein:
55 said client comprises means for sending said volume ID and said issue number to said server; and
said server comprises means for retrieving an expected play time associated with said volume ID and said issue number, and means for adding said expected play time to the value of a total play time associated with said volume ID and said issue number.

33. A system for permitting a user to play an application contained in a distributed application package which further contains, as volume control data, a volume ID for identifying the kind of said distributed application package (said volume), an issue number issued to each volume of the kind in an issued order and an application ID for the application, the system comprising:

5 a client for playing said application; and
a server for controlling said client through a communication network, wherein:
said client comprises means for sending said volume ID, said issue number and said application ID to said server; and
10 said server comprises means for retrieving an expected play time associated with said volume ID, said issue number and said application ID, and means for adding said expected play time to the value of a total play time associated with said volume ID and said issue number.

34. A system for permitting a user to play an application contained in a distributed application package which further contains, as volume control data, a volume ID for identifying the kind of said distributed application package (said volume), an issue number issued to each volume of the kind in an issued order and an application ID for the application, the system comprising:

20 a client for playing said application; and
a server for controlling said client through a communication network, wherein:
said client and said server comprise means for interactively measuring, as a measured play time, a play time of said application; and
said server further comprises means for adding said measured play time to the value of a total play time associated with said volume ID and said issue number.

35. A system as defined in claim 34, wherein said means for interactively measuring a play time comprises means for using a timer of said server.

36. A system as defined in claim 34, wherein said means for interactively measuring a play time comprises means for using a timer of said client.

37. A system for permitting a user to play an application package (the volume) comprising application data and control data wherein at least a part of the control data has been added to the volume after the creation of said volume, the system comprising:

35 a client for playing said volume; and
a server for controlling said client through a communication network, wherein said server comprises means for storing a secret key of said server and said at least a part of said control data includes a public key corresponding to said secret key, and wherein the system comprises:
40 means provided in said server for generating a pseudo random number;
means for storing said pseudo random number;
means provided in said server for transmitting said pseudo random number to said client;
means provided in said client for encrypting desired data with said transmitted pseudo random number into encrypted data;
45 means provided in said client for encrypting concatenated data consisting of said pseudo random number and said encrypted data with said public key into double-encrypted data;
means provided in said client for sending said double-encrypted data to said server;
means provided in said server for decrypting said double-encrypted data with said secret key into decrypted data consisting of a decrypted random number portion and another decrypted portion; and
50 means provided in said server for decrypting said another decrypted portion with said transmitted random number to obtain said desired data.

38. A system as defined in claim 37, further comprising:

55 means, provided in said server, activated prior to said decrypting said another decrypted portion and responsive to a determination that said decrypted random number portion does not coincide with said pseudo random number stored in said means for storing said pseudo random number, for informing said client of a failure in decryption instead of passing the control to next means.

39. A system for permitting a user to play an application contained in a distributed application package which further contains, as volume control data, a volume ID for identifying the kind of said distributed application package (said volume), an issue number issued to each volume of the kind in an issued order and application IDs, the system comprising:

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a client for playing an application by using application data; and
a server for controlling said client through a communication network, wherein said client comprises:
means for reading and sending said volume ID, said issue number and an application ID for said one of
encrypting key-encrypted applications (said encrypting key-encrypted application) from said volume to said
server, said server comprises:
means for proceeding to next step only if the value of a meter field associated with said volume ID, said issue
number and said application ID is under the value of a limit value field associated with said volume ID, said
issue number and said application ID in a volume data table; and
means for causing said client to display a message informing an overlimit on a display device of said client and
quit the operation otherwise.

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40. A system for permitting a user to play an application contained in a distributed application package which further contains, as volume control data, a volume ID for identifying the kind of said distributed application package (said volume), an issue number issued to each volume of the kind in an issued order, application IDs and limit values associated with respective application IDs for limiting the play of respective applications, the system comprising:

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a client for playing an application by using application data; and
a server for controlling said client through a communication network, wherein said client comprises:
means for reading and sending said volume ID, said issue number, an application ID for said one of encrypting
key-encrypted applications (said encrypting key-encrypted application) and a limit value associated with said
application ID from said volume to said server, and wherein said server comprises:
means for proceeding to a next step only if the value of a meter field associated with said volume ID, said issue
number and said application ID in a volume data table is under said limit value; and
means for causing said client to display a message informing an overlimit on a display device of said client and
quit the operation otherwise.

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41. A system as defined in claim 39, wherein said limit value is one of effective date and time, allowable expiration date and time, a maximum amount of play time, and an allowable access count.

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42. A system as defined in any of claims 29, 33 and 34, wherein said means for sending to said server comprises means for encrypting at least one of said volume ID, said issue number and said application ID.

40

43. A method for permitting an authentic user to play a desired one of the applications contained in a distributed application package in a system capable of playing an application, wherein said application package (said volume) contains volume control data including mode codes assigned to said volume and the applications of said volume, the method comprising the steps of:

deciding to use one of predetermined play modes specified by one of said mode codes associated with said
desired application; and
playing said desired application in said specified play mode.

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44. A method as defined in claim 43, wherein the method further comprises the step of including, in said mode codes, values indicative of a free play mode and at least one limit-attached play mode which correspond(s) to respective limit value(s) used for limiting usage.

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45. A method as defined in claim 44, wherein said step of playing said desired application comprises the step of:

in response to a determination that said one of said mode codes associated with said desired application
includes a value indicative of said free play mode, simply playing said desired application.

55

46. A method as defined in claim 44, wherein said step of playing said desired application comprises the step of:

in response to a determination that said one of said mode codes associated with the desired application

includes one of values indicative of said at least one limit-attached play mode, displaying a message to the effect that a limit value associated with said one of values has been reached instead of playing said desired application if said limit value has been reached.

- 5 47. A method as defined in claim 43, wherein said volume control data further includes a volume ID, an issue number and an application ID for each of said applications, and wherein said step of deciding to use one of predetermined play modes comprises the steps of:
- 10 ~~obtaining said one of said mode codes~~ associated with said desired application and corresponding limit value by using said application ID; and
 comparing said one of said mode codes with a meter value associated with said volume ID, said issue number and said application ID.
- 15 48. A method as defined in claim 45, wherein each of said applications has been each encrypted with an encrypting key and said volume control data includes a user's public key-encrypted version of said encrypting key (a public key-encrypted version encrypting key), and wherein said step of simply playing said desired application comprises the steps of:
- 20 ~~reading said user's public key-encrypted~~ encrypting key from said volume;
 obtaining a user's secret key which corresponds to said user's public key;
 decrypting said user's public key-encrypted encrypting key with said user's secret key to obtain said encrypting key; and
 decrypting said desired application with said obtained encrypting key.
- 25 49. A system for permitting an authentic user to play a desired one of the applications contained in a distributed application package, wherein said application package (said volume) contains volume control data including mode codes assigned to said volume and the applications of said volume, the system comprising:
- 30 means for deciding to use one of predetermined play modes specified by one of said mode codes associated with said desired application; and
 means for playing said desired application in said specified play mode.
- 35 50. A system as defined in claim 49, wherein the system further comprises means for including, in said mode codes, values indicative of a free play mode and at least one limit-attached play mode which correspond(s) to respective limit value(s) used for limiting usage.
51. A system as defined in claim 50, wherein said means for playing said desired application comprises:
- 40 means, responsive to a determination that said one of said mode codes associated with said desired application includes a value indicative of said free play mode, for simply playing said desired application.
52. A system as defined in claim 50, wherein said means for playing said desired application comprises:
- 45 means, responsive to a determination that said one of said mode codes associated with the desired application includes one of values indicative of said at least one limit-attached play mode, for displaying a message to the effect that a limit value associated with said one of values has been reached instead of playing said desired application if said limit value has been reached.
- 50 53. A system as defined in claim 49, wherein said volume control data further includes a volume ID, an issue number and an application ID for each of said applications, and wherein said means for deciding to use one of predetermined play modes comprises:
- 55 means for obtaining said one of said mode codes associated with said desired application and corresponding limit value by using said application ID; and
 means for comparing said one of said mode codes with a meter value associated with said volume ID, said issue number and said application ID.
54. A system as defined in claim 51, wherein each of said applications has been encrypted with an encrypting key and

said volume control data includes a user's public key-encrypted version of said encrypting key (a public key-encrypted version encrypting key), and wherein said means for simply playing said desired application comprises:

means for reading said user's public key-encrypted encrypting key from said volume;
 means for obtaining a user's secret key which corresponds to said user's public key;
 means for decrypting said user's public key-encrypted encrypting key with said user's secret key to obtain said encrypting key; and
 means for decrypting said desired application with said obtained encrypting key.

55. A method for permitting an authentic user to play a desired one of the applications contained in a distributed application package in a system comprising a client capable of playing an application and a server connected with said client through a communication network, wherein said application package (hereinafter referred to as "said volume") contains volume control data including mode codes assigned to said volume and the applications of said volume, the method comprising the steps of:

said client deciding to use one of predetermined play modes specified by one of said mode codes associated with said desired application; and
 playing said desired application in said specified play mode by means of cooperation between said client and said server.

56. A method as defined in claim 55, wherein the method further comprises the step of including, in each of said mode code, a value indicative of one of a free play mode, a charged play mode and at least one limit-attached play mode, wherein said volume control data further comprises a limit value associated with each of said at least one limit-attached play mode.

57. A method as defined in claim 55 or 56, wherein said volume control data further includes a volume ID, an issue number, and an application ID for each of said applications, and wherein said step of playing said desired application in said specified play mode includes an application play step of simply playing said specified application.

58. A method as defined in claim 57, wherein each of said applications contained in a distributed application package has been encrypted with an encrypting key and said volume control data includes a user's public key-encrypted version of said encrypting key (a public key-encrypted version encrypting key), and wherein said application play step comprising the steps of:

reading said user's public key-encrypted encrypting key from said volume;
 obtaining a user's secret key which corresponds to said user's public key;
 decrypting said user's public key-encrypted encrypting key with said user's secret key to obtain said encrypting key; and
 decrypting said desired application with said obtained encrypting key.

59. A method as defined in claim 57, wherein each of said applications contained in a distributed application package has been encrypted with an encrypting key and said volume control data includes a user's public key-encrypted version of said encrypting key (a public key-encrypted version encrypting key), and wherein said application play step comprises the steps of:

in said server,

retrieving an encrypting key by using said volume ID;
 retrieving a user's public key associated with said volume ID and said issue number;
 double-encrypting said encrypting key with a pseudo random number and said user's public key into a double encrypted data;
 sending said double-encrypted data to said client; in said client,
 obtaining a user's secret key which corresponds to said user's public key;
 obtaining said encrypting key by decrypting said double-encrypted data with said user's secret key;
 decrypting said desired application with said obtained encrypting key.

60. A method as defined in claim 57, wherein said step of playing said desired application further comprises the steps, executed prior to said application play step, of:

said server retrieving an expected play time associated with said desired application; and displaying said expected play time on a display device of said client.

- 5 61. A method as defined in claim 57, wherein said step of playing said desired application further comprises the steps of:

measuring, as a measured play time, a duration of said application play step;
adding said measured play time to a play time meter associated with said mode code to obtain a total amount of play time; and
10 displaying said measured play time and said total amount of play time on a display device of said client after said application play step.

62. A method as defined in claim 61, wherein said step of measuring a duration comprises the step of measuring said play time by using a timer of said server.

- 15 63. A method as defined in claim 61, wherein said step of measuring a duration comprises the step of measuring said play time using a timer of said client.

- 20 64. A method as defined in claim 57, wherein said step of deciding to use one of predetermined play modes comprises deciding to use said charged play mode if said one of said mode codes associated with said desired application includes a value indicative of said charged play mode, and wherein said step of playing said desired application comprises the steps of:

said client obtaining and sending a credit card number of said user to said server;
25 proceeding to a next step only if the credit card of said number is found to be valid from a reference to an associated credit company;
displaying, on a display device of said client, a charge for play decided based on a measurement of a duration of said application play step and a total amount of play charges after said application play step; and
said server charging said play to said credit card number.

- 30 65. A method as defined in claim 64, wherein said step of playing said desired application further comprises the steps, prior to said application play step, of:

35 displaying, prior to said application play step, an expected charge and an expected total amount of charges on said display device; and
letting the user decide whether to play said desired application.

66. A method as defined in claim 64, wherein said step of said client obtaining and sending a credit card number of said user to said server comprises the steps of:

40 in said server,

generating a pseudo random number;
storing said pseudo random number in memory;
45 transmitting said pseudo random number to said client;

in said client,

prompting said user to input said credit card number;
50 double-encrypting said credit card number first with said transmitted random number and then with a server's public key included in said volume control data into a double-encrypted number;
sending said double-encrypted number to said server; in said server,
decrypting said double-encrypted number with a server's secret key into a decrypted random number and another decrypted data; and
55 decrypting said another decrypted data with said transmitted random number to obtain said credit card number.

67. A method as defined in claim 66, wherein said step of said client obtaining and sending a credit card number of said

user to said server further comprises the steps, executed prior to said step of decrypting said another encrypted data, of:

5 proceeding to a next step only if said decrypted random number coincides with said pseudo random number which has been stored in said memory; and
displaying a message informing a failure in decryption and quitting the operation otherwise.

68. A method as defined in claim 57 wherein said step of deciding to use one of predetermined play modes comprises deciding to use one of said at least one limit-attached play mode if said one of said mode codes associated with
10 said desired application includes a value indicative of said one of said at least one limit-attached play mode, and wherein said step of playing said desired application comprises the step of:

15 in response to a determination that a meter value associated with said one of said mode codes associated with said desired application in a record identified by said volume ID, said issue number and an application ID of said desired application in a volume data table has reached a limit value associated with said mode code, displaying a message informing an overlimit on a display device of said client instead of executing said application play step.

69. A method as defined in claim 68, wherein said limit value is one of effective date and time, allowable expiration date and time, a maximum amount of play time, and an allowable access count.

70. A system for playing a distributed application package in one of predetermined play modes in concert with a server, wherein the application package contains a data set encrypted with an encrypting key (a K-encrypted data set) for each of at least one application and volume control data for use in controlling operation of the system and the
25 server and the volume control data includes mode codes defining said play modes, the system comprising:

30 means for permitting a user to select one of said at least one application of said volume;
means for deciding to use one of said predetermined play modes associated with one of said mode codes assigned to said selected application; and
means for playing said selected application in said selected play mode in concert with said server.

71. A system as defined in claim 70, wherein each of said mode codes includes one of values for a free play mode, a charged play mode and at least one limit-attached play mode.

35 72. A system as defined in claim 70, wherein said volume control data further includes a volume ID, an issue number and an application ID for each of said applications, and wherein said means for playing said selected application in said selected play mode at least comprises:

40 means for setting said server for said selected play mode by sending to said server said volume ID, said issue number, and the application ID and said mode code associated with said selected application; and
application play means for simply playing said specified application.

73. A system as defined in claim 72, wherein said volume control data further includes a user's public key-encrypted encrypting key, and wherein said application play means comprises:

45 means for reading said user's public key-encrypted encrypting key from said volume;
means for obtaining a user's secret key which corresponds to said user's public key;
means for decrypting said user's public key-encrypted encrypting key with said user's secret key to obtain said encrypting key; and
50 means for decrypting the K-encrypted data set of said selected application with said obtained encrypting key.

74. A system as defined in claim 73, wherein means for decrypting said user's public key-encrypted encrypting key and said means for decrypting the K-encrypted data set are realized as an integrated circuit.

55 75. A system as defined in claim 72, wherein said application play means comprises:

means for receiving double-encrypted data from said server;
means for obtaining a user's secret key which corresponds to said user's public key;

means for obtaining said encrypting key by decrypting said double-encrypted data with said user's secret key;
and
means for decrypting the K-encrypted data set of said selected application with said obtained encrypting key.

5 76. A system as defined in claim 75, wherein means for obtaining said encrypting key and said means for decrypting the K-encrypted data set are realized as an integrated circuit.

77. A system as defined in claim 74 or 76, wherein said integrated circuit is incorporated into said means for obtaining a user's secret key.

10 78. A system as defined in claim 73, wherein said means for deciding to use one comprises means for deciding to use a free play mode and wherein said means for playing said selected application further comprises: means, prior to said application play means, of:

15 means for receiving data from said server; and
displaying said data as an expected play time for said selected application.

79. A system as defined in claim 73, wherein said means for deciding to use one of said predetermined play modes comprises means for deciding to use a free play mode, and wherein said means for playing said selected application further comprises:

20 means for causing said server to obtain, as a measured play time, data of a operation period of said application play means;
means for receiving first and second data from said server; and
25 means for displaying, just after the completion of operation by said application play means, said first and second data as said measured play time and a total amount of play time. data as said measured play time and a total amount of play time.

80. A system as defined in claim 79, wherein said means for causing said server to obtain data of said operation period comprises means for informing said server of the start and the end of operation by said application play means to utilize a timer of said server.

81. A system as defined in claim 79, wherein said means for causing said server to obtain data of a operation period comprises:

35 means for measuring said operation period of said application play means; and
means for sending said operation period to said server for use in a calculation of said total amount of play time.

82. A system as defined in claim 72, wherein said means for deciding to use one comprises means for deciding to use a charged play mode and wherein said means for playing said selected application further comprises:

40 means for obtaining and sending a credit card number of said user to said server;
means responsive to a verification result of said credit card from said server for starting a next process only if said result is positive; and
45 means for displaying a charge for play decided based on a measured play time of said application play means and a total amount of play charges after operation of said application play means.

83. A system as defined in claim 82, wherein said means for playing said selected application further comprises:

50 means activated prior to operation of said application play means for displaying an expected charge and an expected total amount of charges and letting the user decide whether to play said selected application.

84. A system as defined in claim 82, wherein said volume control data of said distributed application package further includes a server's public key, and wherein said means for obtaining and sending a credit card number of said user to said server comprises:

55 means for prompting said user to input said credit card number;
means for receiving a random number from said server;

means for obtaining said server's public key from said volume;
 means for double-encrypting said credit card number first with said random number and then with said server's public key into a double-encrypted data;
 sending said double-encrypted number to said server;

85. A system as defined in claim 84, wherein said means for said client obtaining and sending a credit card number of said user to said server further comprises:

means responsive to a positive result of random number check from said server for starting a next process; and
 means responsive to a negative result of said random number check from said server for displaying a message indicative of a failure in said random number check and quitting the operation for said selected application.

86. A system as defined in claim 72, wherein:

said means for deciding to use one comprises means for deciding to use a limit-attached play mode; and
 said sending to said server includes sending a limit value associated with said mode code, and wherein said means for playing said selected application further comprises:
 means operative prior to operation of said application play means for receiving from said server a limit check result indicative of whether a limit value associated with said mode code has been reached; and
 means responsive to an over limit case of said result for starting a next operation.

87. A system as defined in claim 86, wherein said limit value is one of effective date and time, allowable expiration date and time, a maximum amount of play time, and an allowable access count.

88. A system for controlling through a communication network a client device to play a distributed application package in one of predetermined play modes, wherein the application package contains a data set encrypted with an encrypting key (a K-encrypted data set) for each of at least one application and volume control data for use in controlling operation of the system and the client and the volume control data includes a volume ID, an issue number, an application ID for each of said applications, and a mode code for said volume or mode codes for said applications, the system comprising:

volume data table for storing, for each volume, said volume ID, said issue number, said mode code for said volume, and said application ID and said mode code for each of said applications;
 means for receiving a service request, a volume ID, an issue number, an application ID and a mode code and other data from said client;
 means for storing said received application ID, said received mode code and other data in appropriate fields of a record identified by said volume ID and said issue number;
 means responsive to a determination that there is no record identified by said volume ID and said issue number in said volume data table for adding said record in said volume data table and storing said received application ID and mode code and said other data in relevant fields of said record; and
 means operative on the basis of said received mode code for deciding to subsequently passing the control to means for supporting a play mode associated said received mode code.

89. A system as defined in claim 88, wherein said means for supporting a play mode at least comprises means for supporting application play means, of client, for simply playing an application identified by said received application ID, and wherein said means for supporting said application play means of said client comprises:

first means for associating a given volume ID with a corresponding encrypting key;
 second means for associating both a given volume ID and issue number with a corresponding user's public key;
 means for retrieving an encrypting key associated with said received volume ID from said first means;
 means for retrieving a user's public key associated with said received volume ID and issue number from said second means;
 means for double-encrypting said encrypting key with a pseudo random number and said user's public key into a double encrypted data; and
 sending said double-encrypted data to said client.

90. A system as defined in claim 89, further comprising an application data table for storing data for each kind of appli-

EP 0 840 194 A2

cation, wherein said received mode code defines a free play mode, and wherein said means for supporting a play mode associated said received mode code comprises:

means, activated prior to an operation of said means for supporting application play means of said client, for retrieving an expected play time associated with said received application ID from said application data table; and
means for sending said expected play time to said client.

91. A system as defined in claim 89, wherein said received mode code defines a free play mode, and wherein said means for supporting a play mode associated said received mode code comprises:

means for measuring, as a measured play time, a duration of application play;
means for adding said measured play time to a play time meter associated with said received mode code in said volume data table to obtain a total amount of play time; and
means for sending said measured play time and said total amount of play time to said client.

92. A system as defined in claim 91, wherein said means for measuring a duration comprises:

means responsive to a notice of the start of operation by said application play means of said client for starting a timer; and
means responsive to a notice of the end of said operation for stopping said timer.

93. A system as defined in claim 91, wherein said means for measuring a duration comprises:

means for receiving a measured duration from said client.

94. A system as defined in claim 88, wherein said received mode code defines a charged play mode, and wherein said means for supporting a play mode associated said received mode code comprises:

means for receiving a credit card number of said user from said server;
means, responsive to a determination, from a verification of said credit card number, that said credit card number is not valid, for informing said client of invalidity and quitting the operation of said means for supporting a play mode;
means, responsive to a determination, from said verification of said credit card number, that said credit card number is valid, for informing said client of a validity and proceeding to a next operation; and
means for charging said play to said credit card number.

95. A system as defined in claim 94, wherein said means for supporting a play mode associated said received mode code further comprises:

means activated prior to operation of said application play means of said client for retrieving an expected charge from said application data table by using said received application ID;
means for calculating a sum of said expected charge and a value of a charge meter associated with said received volume ID or application ID depending on said received mode code;
means operative prior to operation of said application play means for sending said expected charge and said sum to said client; and
means responsive to a receipt of a message of quitting for quitting said means for supporting a play mode.

96. A system as defined in claim 94, wherein said means for receiving a credit card number of said user from said server comprises:

means for generating a pseudo random number;
means for storing said pseudo random number in memory;
means for transmitting said pseudo random number to said client;
means for waiting for a double-encrypted data from said client;
means for obtaining a server's secret key;
means for decrypting said double-encrypted number with said server's secret key into a decrypted random number and another decrypted data; and

means for decrypting said another encrypted data with said transmitted random number to obtain said credit card number.

5 97. A system as defined in claim 96, wherein said means for obtaining a user's secret key comprises means for reading said user's secret key from a portable memory of said user.

98. A system as defined in claim 96, wherein said means for receiving a credit card number of said user from said server further comprises:

10 means responsive to a determination, made prior to said decrypting said another, that said decrypted random number coincides with said pseudo random number which has been stored in said memory for sending an enable message to said client and proceeding to a next operation; and
 15 means responsive to a determination, made prior to said decrypting said another, that said decrypted random number does not coincide with said pseudo random number which has been stored in said memory for sending a disable message to said client and quitting said supporting a play mode.

99. A system as defined in claim 88, wherein:

20 said received mode code defines a limit-attached play mode; and
 means for receiving a service request further receives a limit value associated with said mode code, and wherein said means for supporting a play mode associated said received mode code comprises:
 means for proceeding to a next operation only if the value of a software meter associated with said mode code in said volume data table is under said limit value; and
 25 means for sending a message informing an over limit to said client and quitting the operation of said means for supporting a play mode associated said received mode code if the value of a software meter associated with said mode code in said volume data table is not under said limit value.

30 100. A system as defined in claim 99, wherein said limit value is one of effective date and time, allowable expiration date and time, a maximum amount of play time, and an allowable access count.

101. A system as defined in any of claims 54, 73 and 75, wherein said means for obtaining a user's secret key comprises means for reading said user's secret key from a portable memory of said user.

35 102. A system as defined in claim 28 or 29, wherein said means for obtaining said secret key comprises means for reading said user's secret key from a portable memory of said user.

103. A method as defined in any of claims 10, 11, 19, 21, 22 and 55, wherein said application package is recorded on a package media.

40 104. A method as defined in claim 103, wherein said package media is of a write-once type, and said client is a system capable of playing said package media of said write-once type.

105. An application package as defined in claim 1, wherein said package media is distributed to a purchaser thereof or a subscriber thereof via a transmission media.

45 106. A system as defined in any of claims 28, 29, 37, 39, 40, 70 and 88, wherein said application package is recorded on a package media.

50 107. A system as defined in claim 106, wherein said application package is recorded on a package media of a write-once type.

108. A system as defined in claim 106, wherein at least a part of said volume control data is recorded, after manufacturing said package media, in an area different from a data area where said at least one application is recorded.

55 109. A system as defined in claim 108, wherein said client is a system provided with means for playing said package media of said write-once type.

110. A system as defined in any of claims 28, 29, 37, 39, 40, 70 and 88, wherein said application package is recorded

EP 0 840 194 A2

on a DVD and at least a part of said volume control data is recorded, after manufacturing said package media, in a BCA (burst cutting area) of the DVD, and wherein said client is a system provided with means for playing said DVD.

5 111. A method as defined in any of claims 10, 11, 19, 21, 22, 43 and 55, wherein the application package has been distributed to a purchaser thereof or a subscriber via a transmission media and at least a part of said volume control data has been added to said application package after preparing said application package.

10 112. A system as defined in any of claims 28, 29, 37, 39, 40, 49, 70 and 88, wherein said application package has been distributed to a purchaser thereof or a subscriber thereof via a transmission media and at least a part of said volume control data has been added to said application package after preparing said application package.

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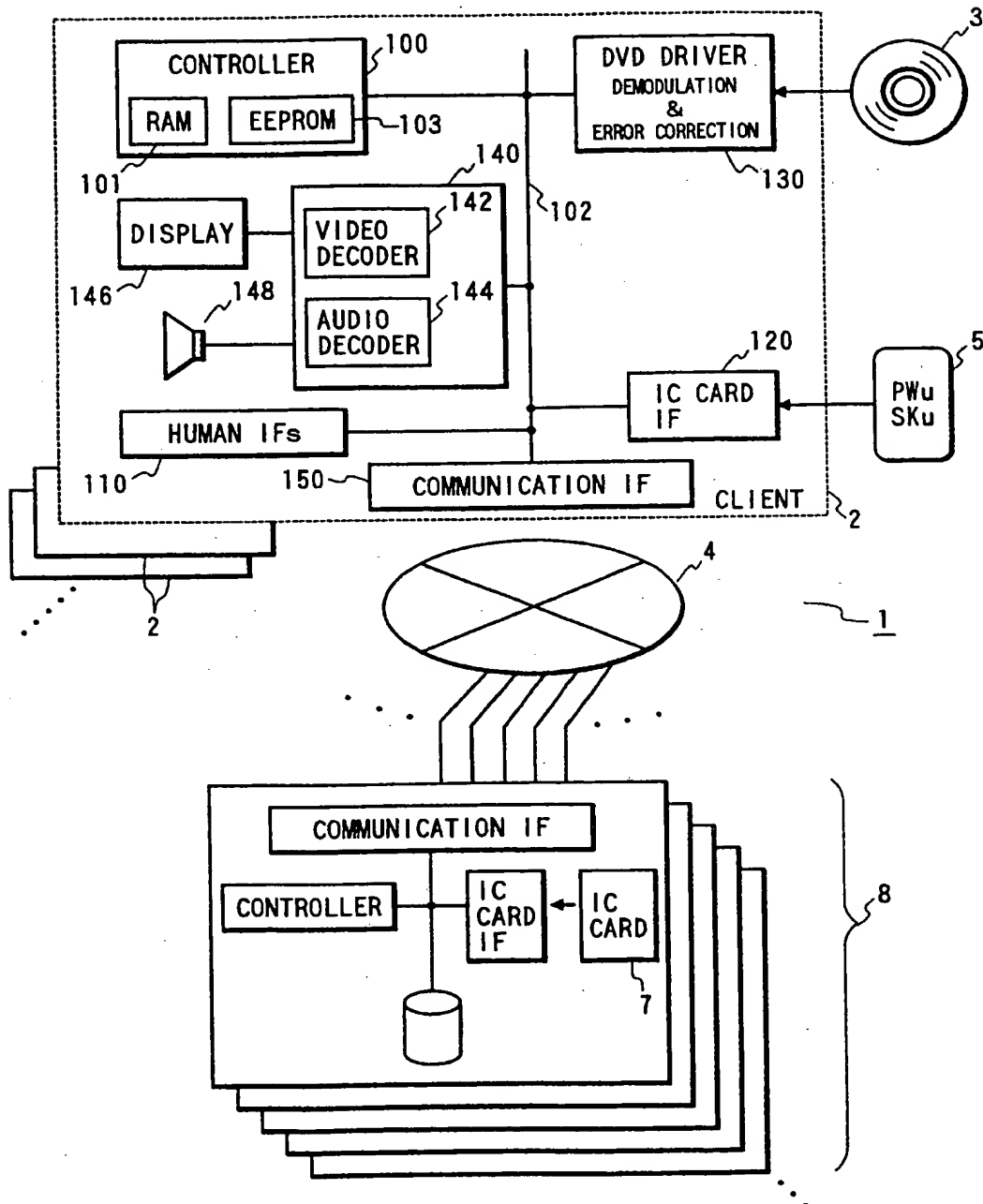
40

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FIG. 1



*FIG. 2*20

BURST CUTTING AREA	DISTRIBUTION DESCRIPTOR	23
DATA AREA	VOLUME DESCRIPTOR	22
	VOLUME CONTROL PROGRAM	24
	APPLICATION (APPLICATION)	21
	⋮	

FIG. 3

VOLUME IDENTIFIER (VID _v)	25
PROVIDER IDENTIFIER (PID _p)	26
⋮	
VOLUME CREATION DATE AND TIME	27
VOLUME EFFECTIVE DATA AND TIME	28
⋮	
(APPLICATION IDENTIFIER 1)	29
(APPLICATION IDENTIFIER 2)	
⋮	
⋮	

FIG. 4

23

VOLUME ISSUE NUMBER (NO _v i)	30
⋮	
SERVER PUBLIC KEY (PK ₁)	31
(PK ₂)	
⋮	
PK _u -ENCRYPTED AP-ENCRYPTING KEY (K _v) = e ₁ (PK _u , K _v)	32
⋮	
SALES DATE AND TIME	33
TERMS-OF-USE CODE PLUS LIMIT VALUE FOR THE VOLUME	34
(TERMS-OF-USE CODE PLUS LIMIT VALUE FOR APPLICATION 1)	35
(TERMS-OF-USE CODE PLUS LIMIT VALUE FOR APPLICATION 2)	
⋮	

FIG. 5

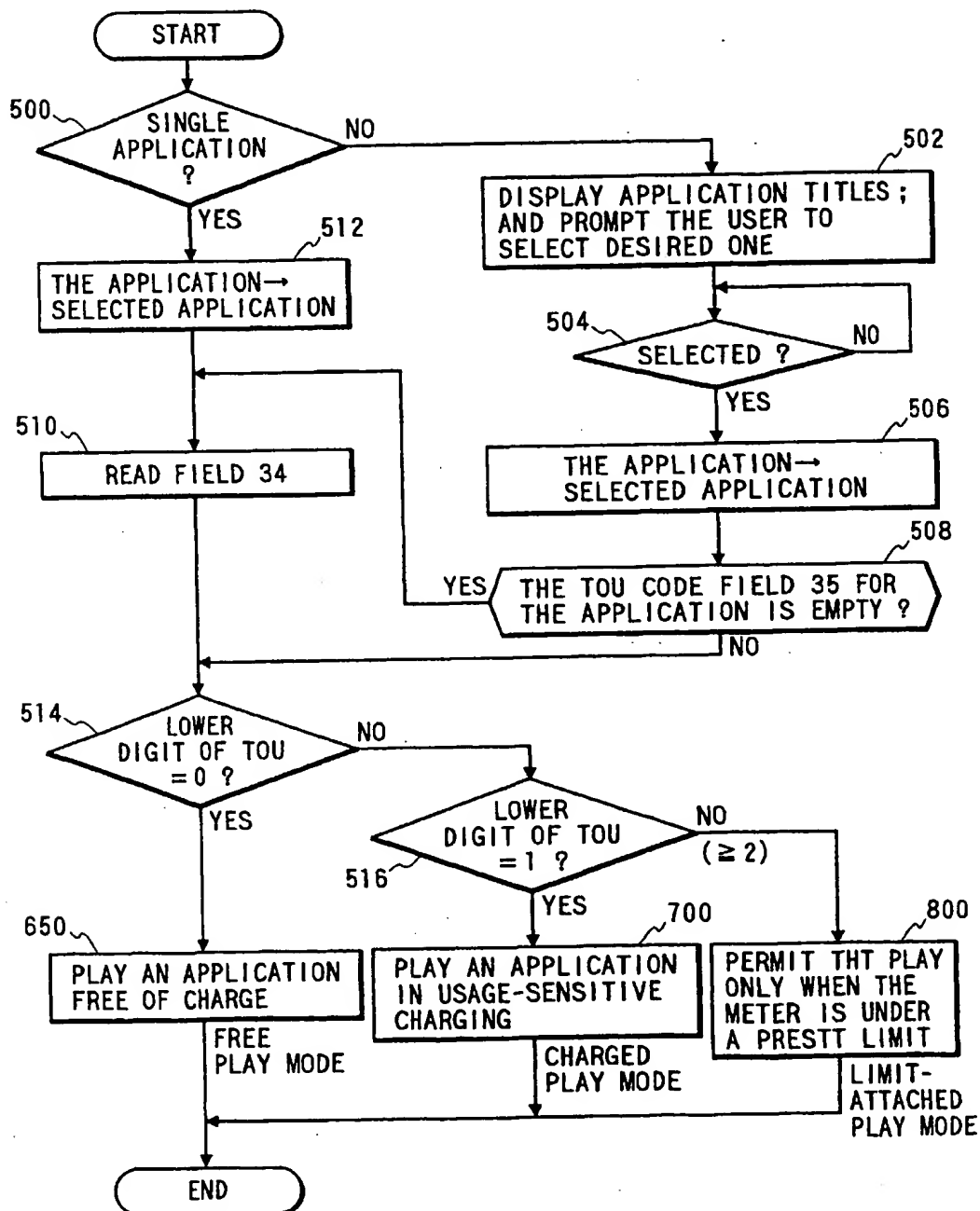


FIG. 6A

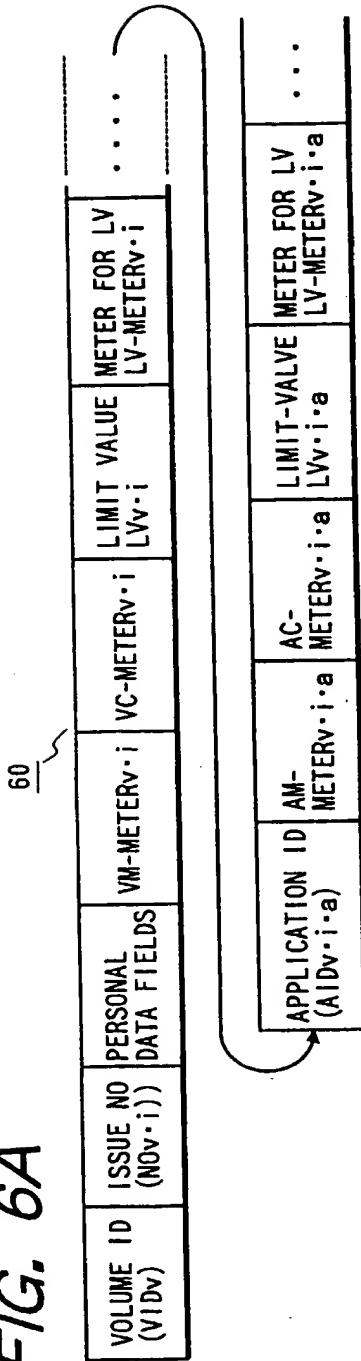


FIG. 6B

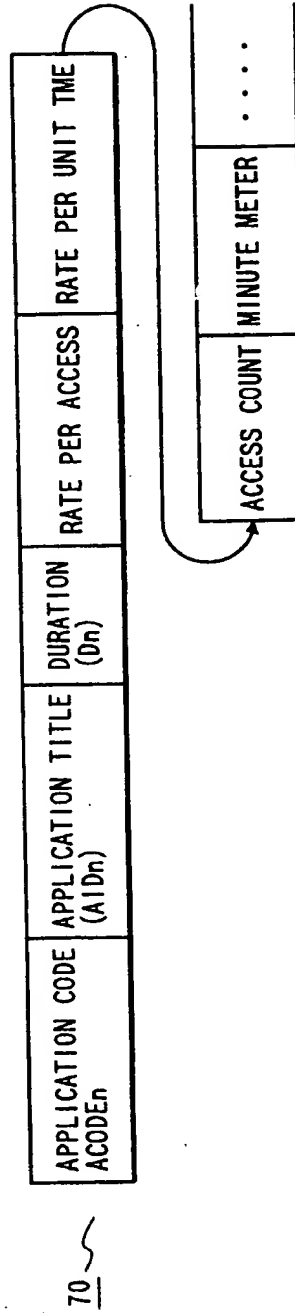


FIG. 7

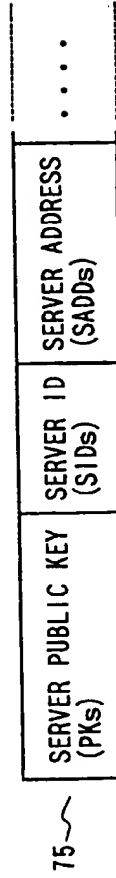


FIG. 8A

FIG. 8B

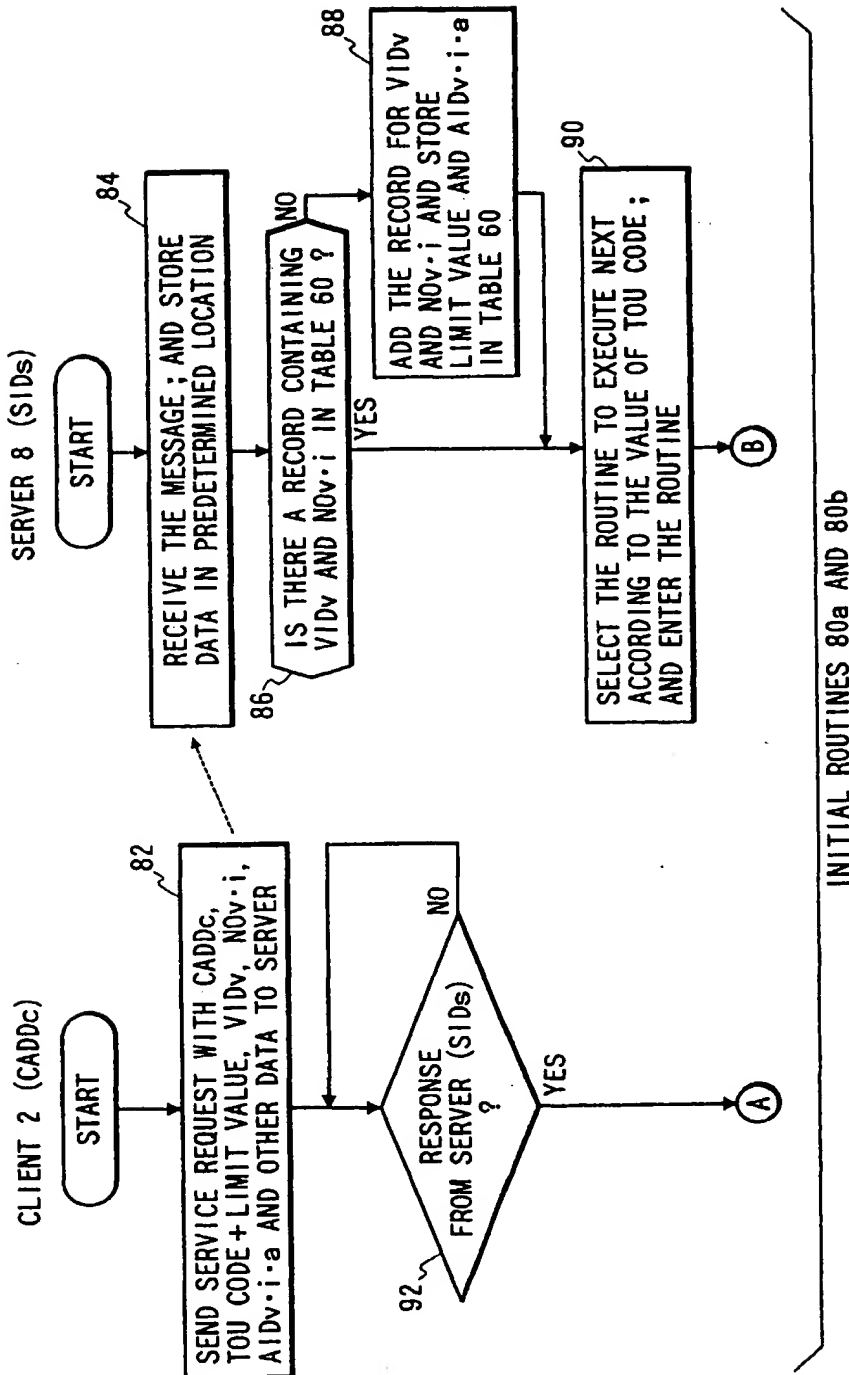


FIG. 9

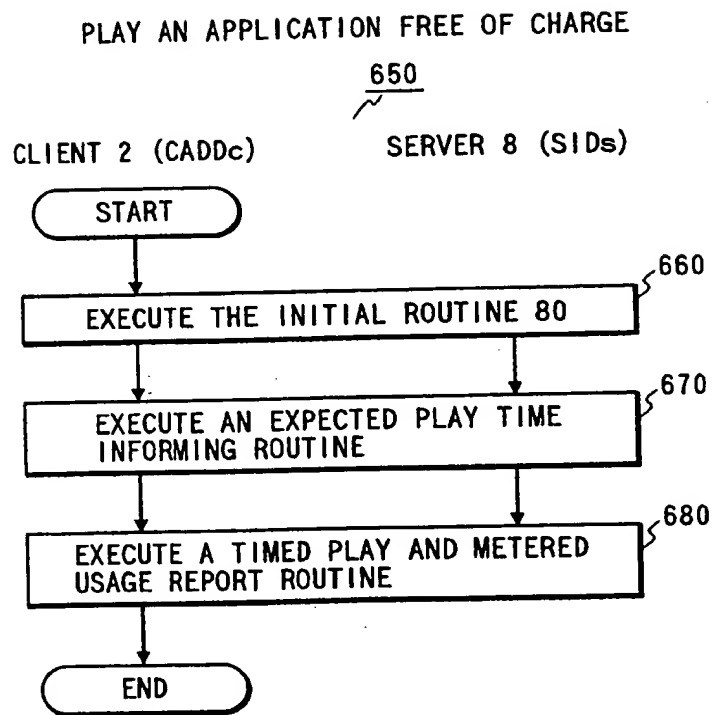


FIG. 10A

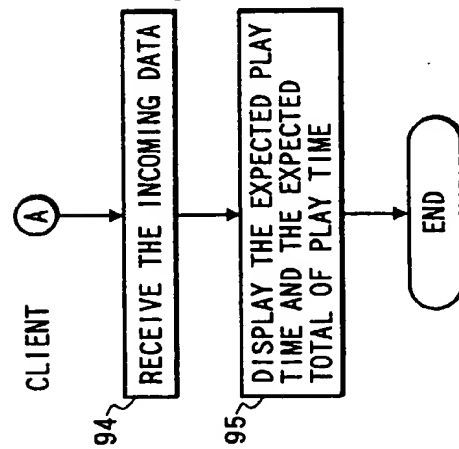
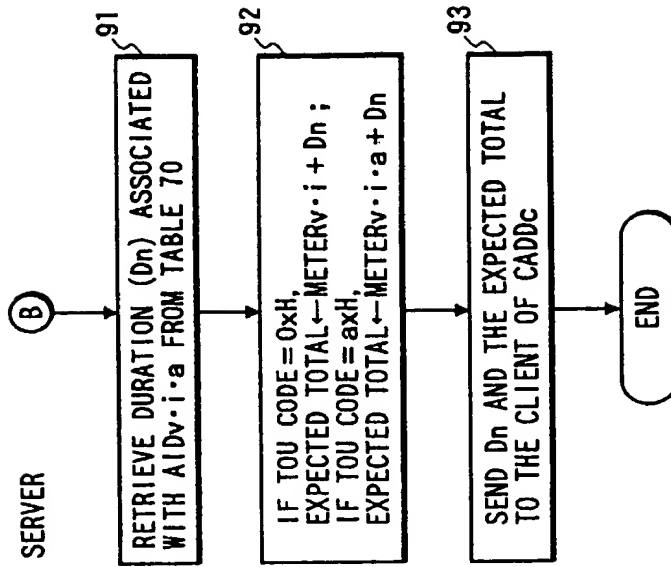


FIG. 10B



EXPECTED PLAY TIME INFORMING ROUTINES 97a AND 97b

FIG. 11A

TIMED PLAY AND METERED USAGE REPORT ROUTINES 675a AND 675b

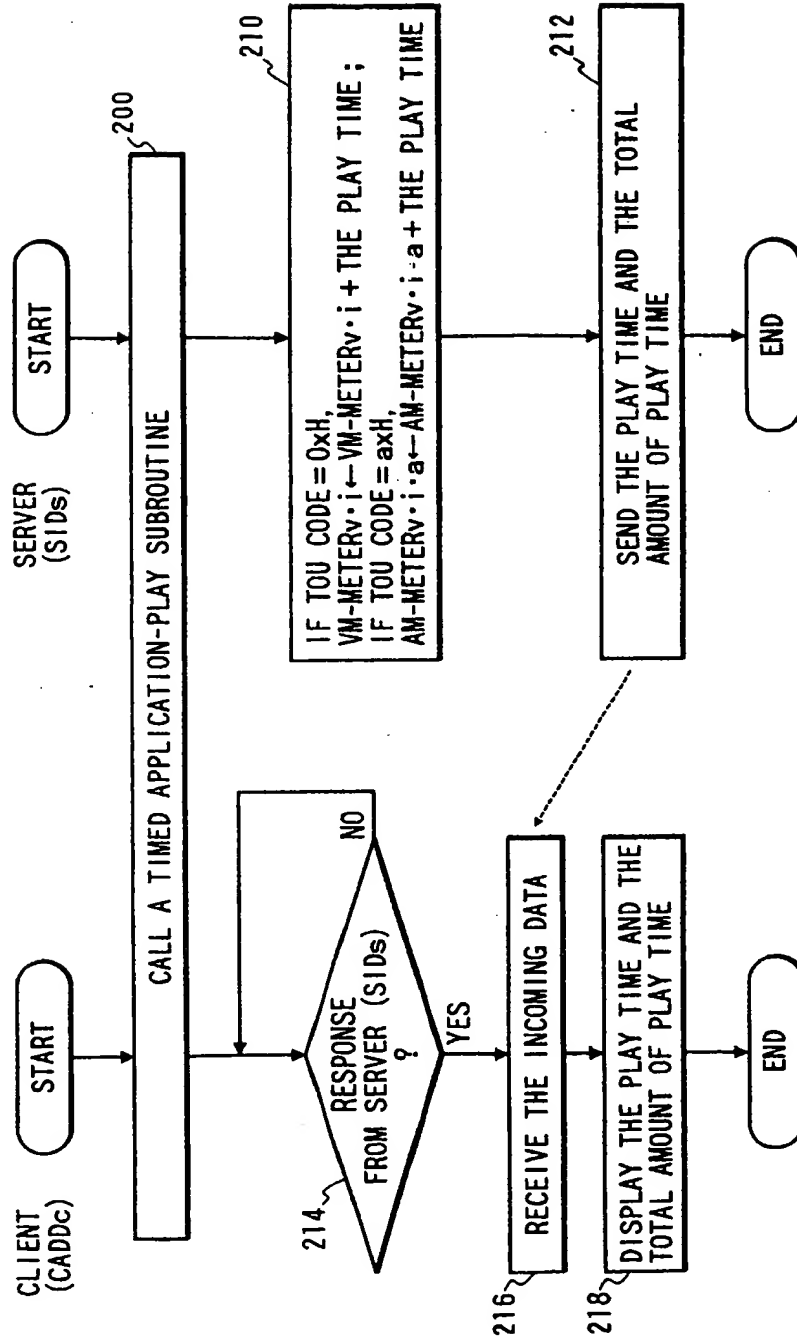


FIG. 12A

FIG. 12B

TIMED APPLICATION-PLAY SUBROUTINES

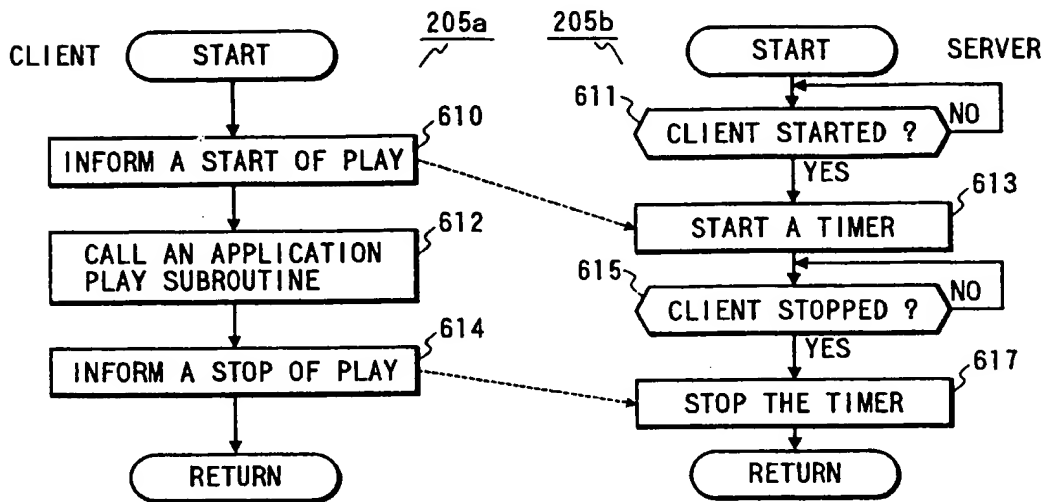


FIG. 13A

FIG. 13B

TIMED APPLICATION-PLAY SUBROUTINES

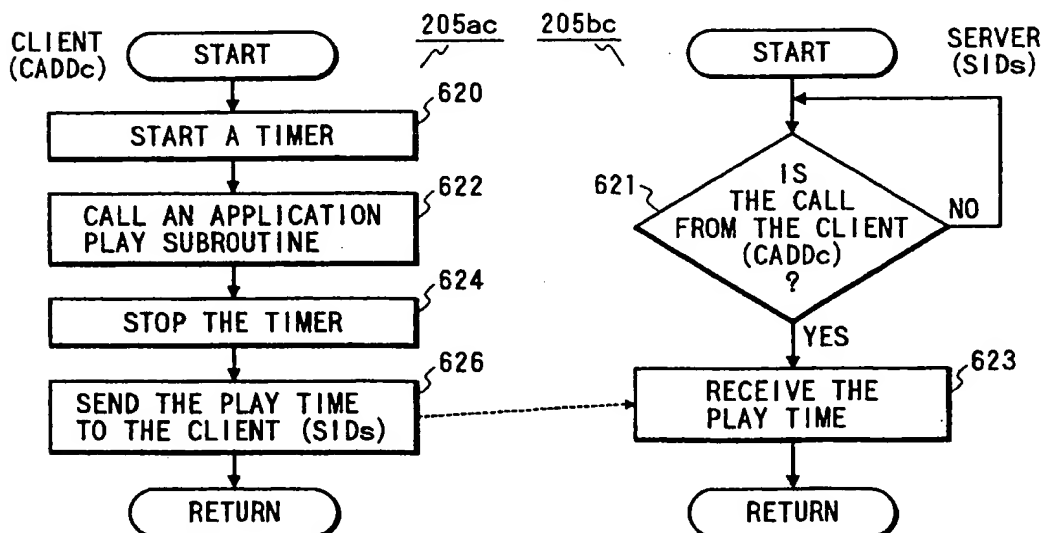


FIG. 14

APPLICATION PLAY SUBROUTINE

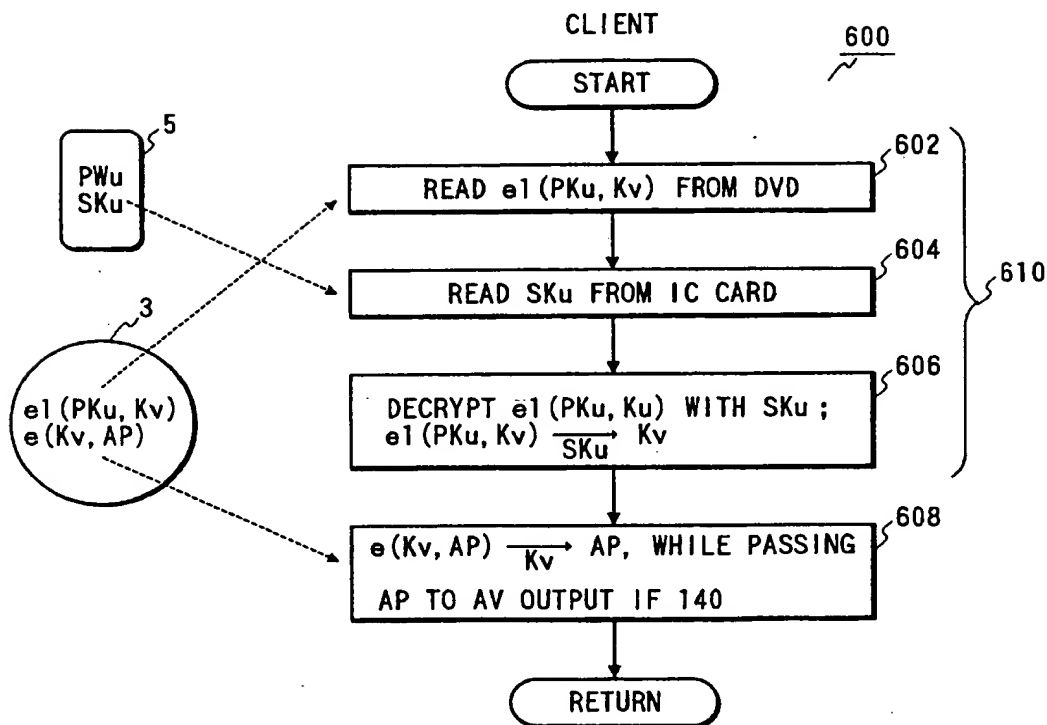


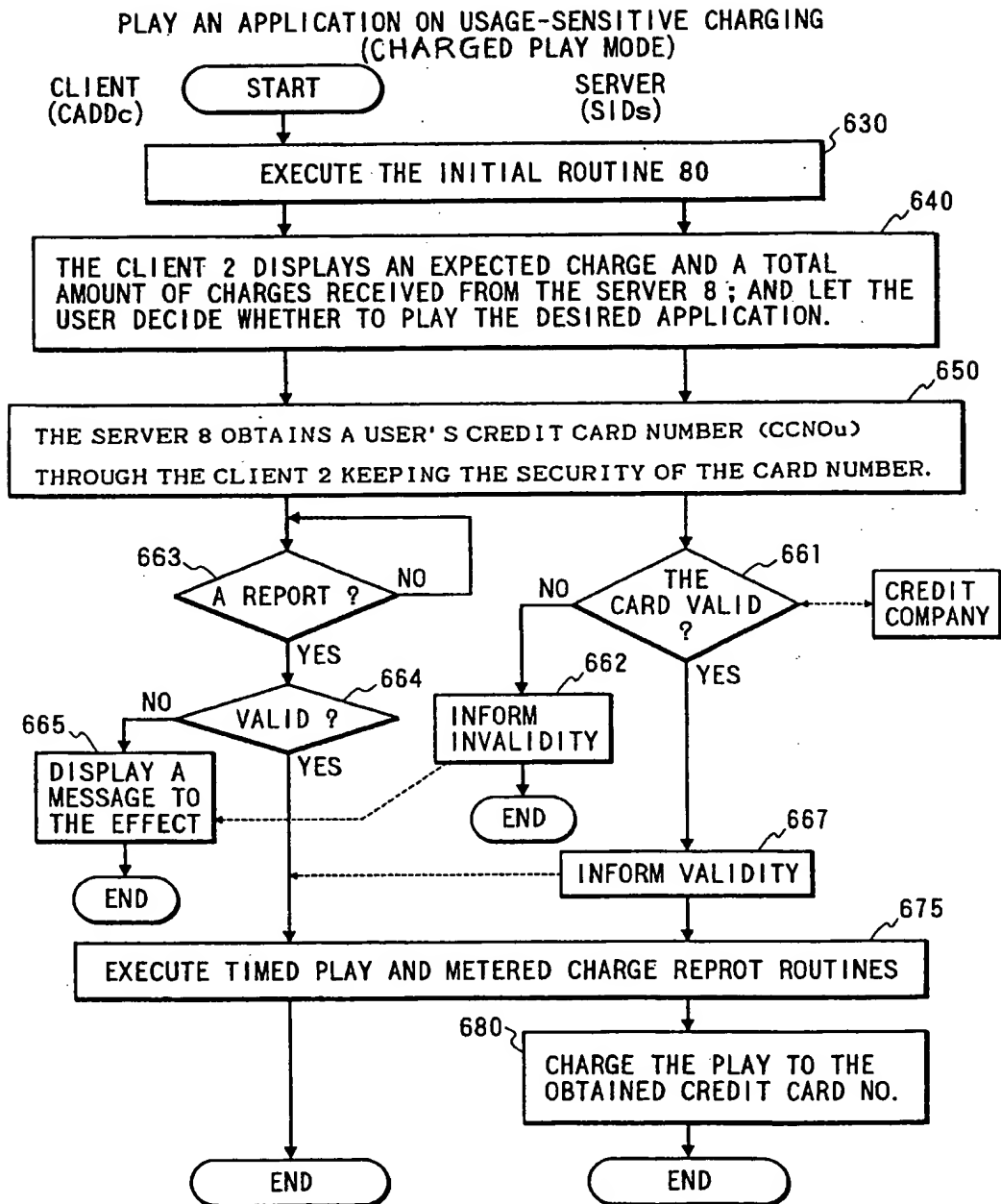
FIG. 15

FIG. 16B

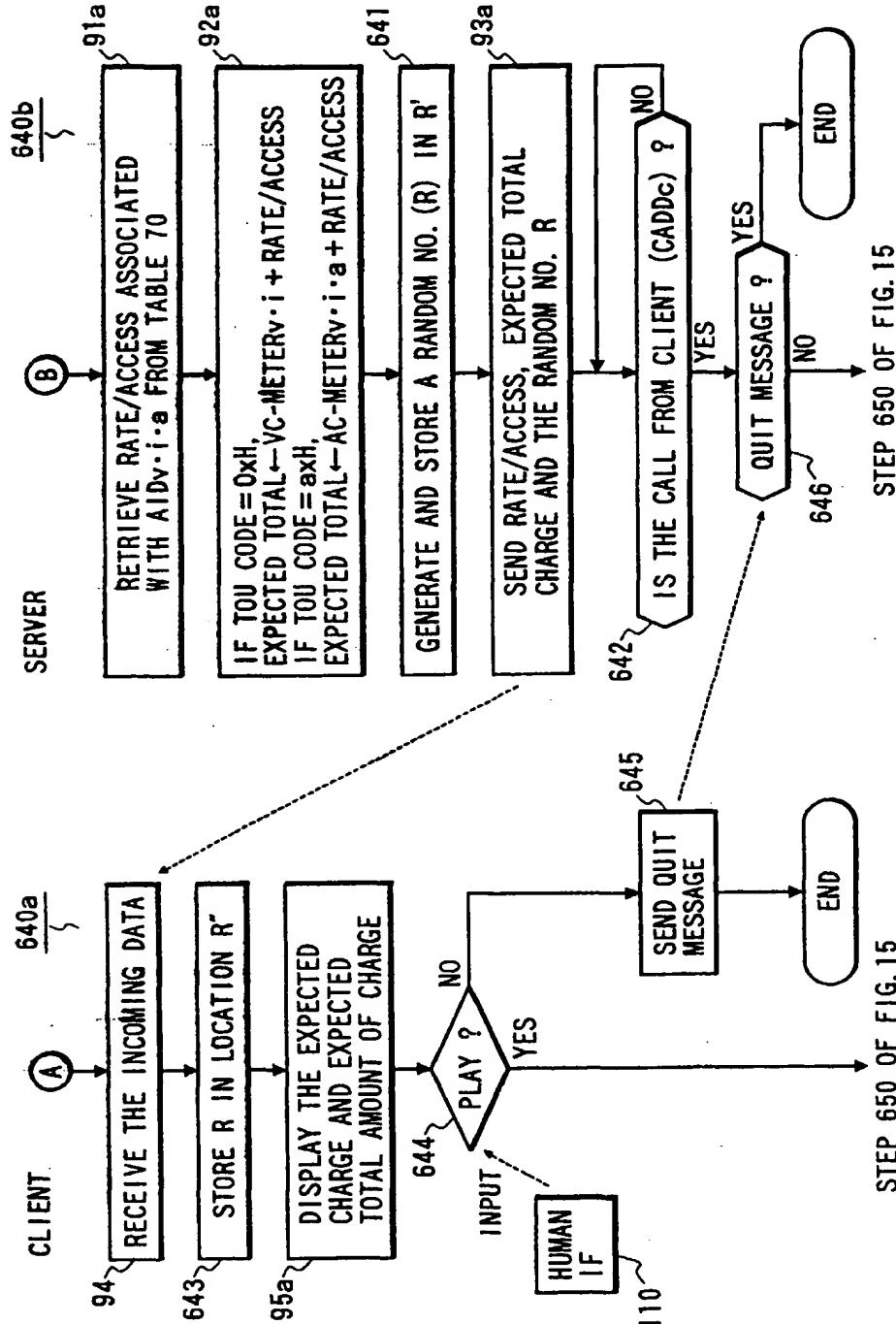
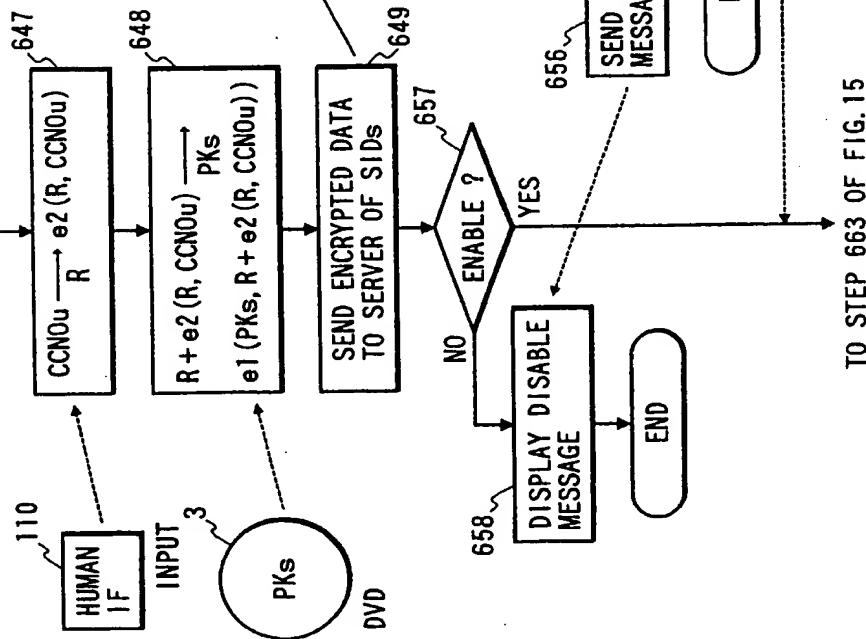
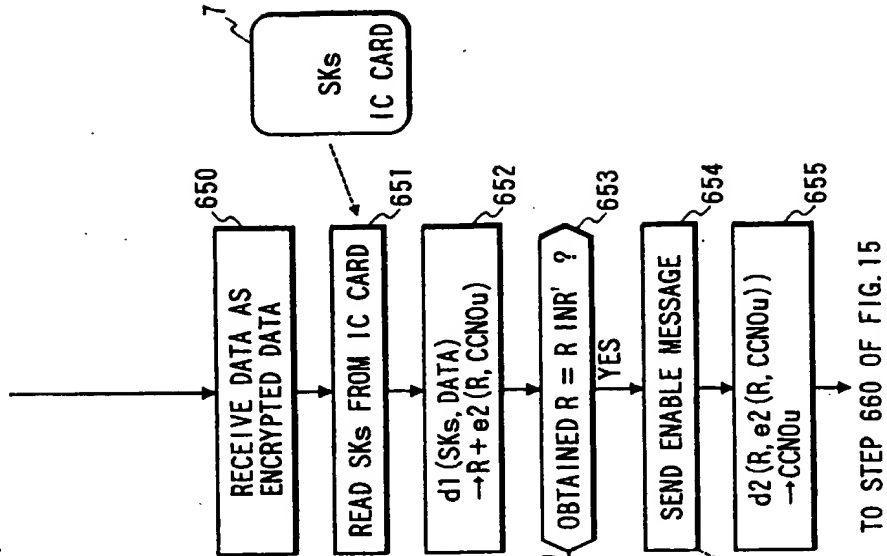


FIG. 17A

FROM BLOCK 640 OF FIG. 15
(STEP 644 OF FIG. 16A)

TO STEP 663 OF FIG. 15

FIG. 17B

FROM BLOCK 640 OF FIG. 15
(STEP 646 OF FIG. 16B)

TO STEP 660 OF FIG. 15

FIG. 18A

FIG. 18B

TIMED PLAY AND METERED CHARGE REPORT ROUTINES

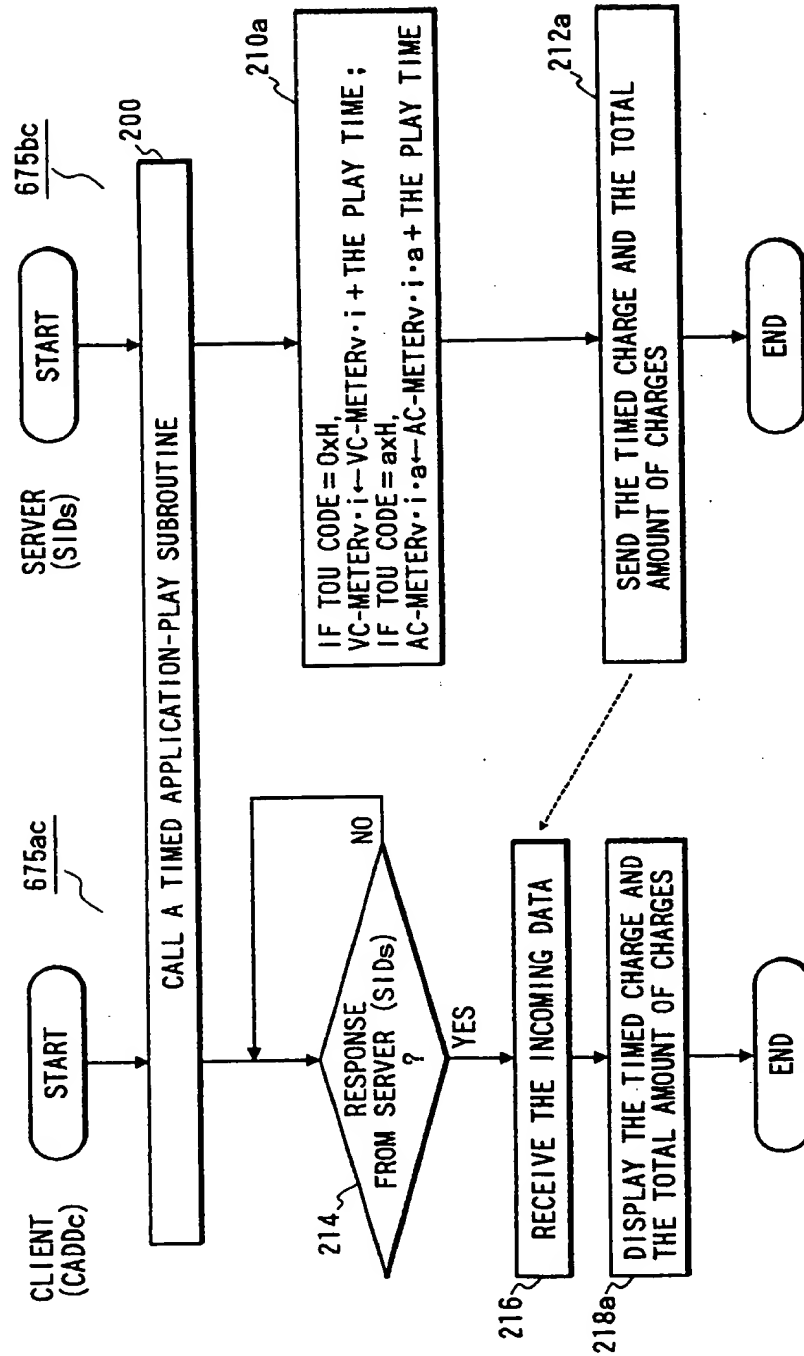


FIG. 19

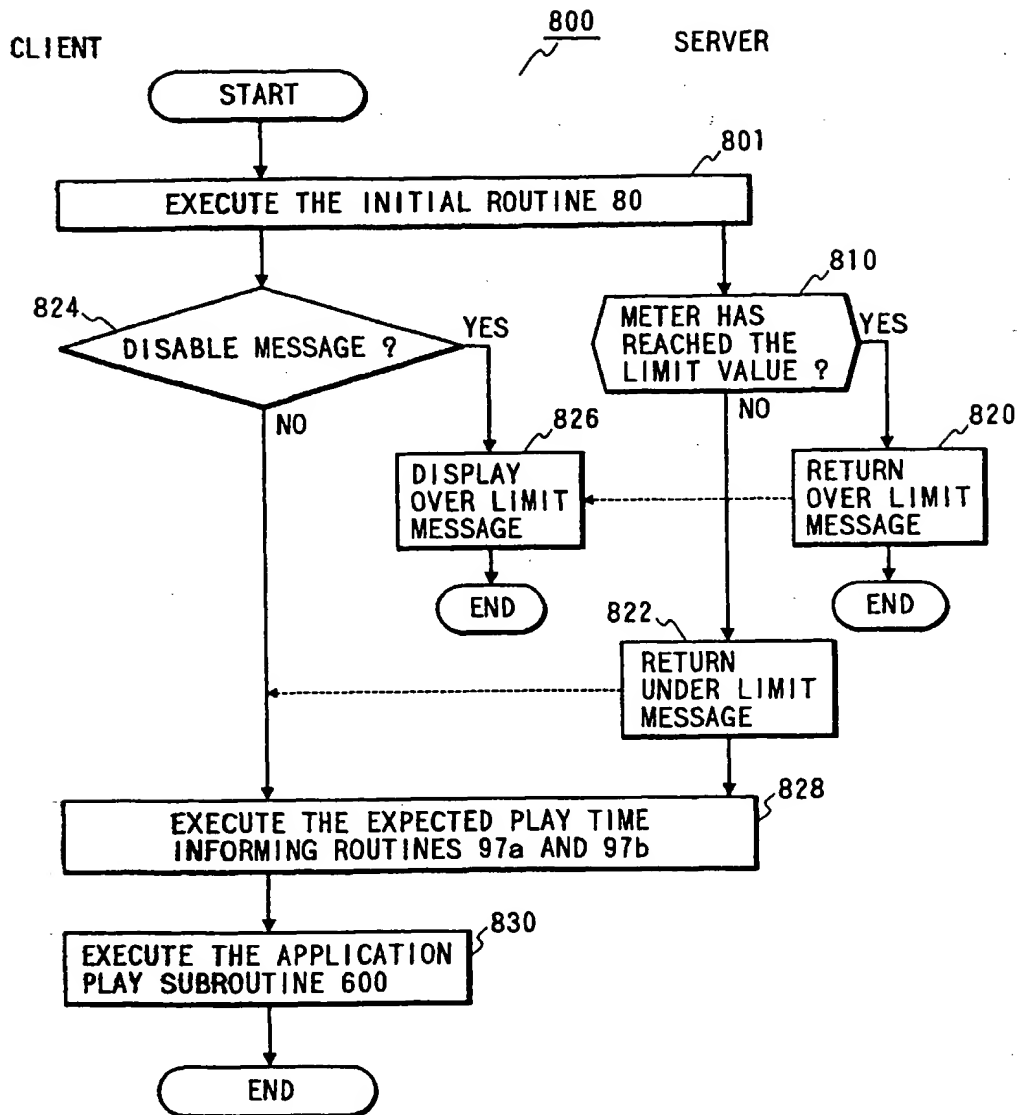


FIG. 20A

VID _v	K _v
VID1	K1
VID2	K2
⋮	⋮

FIG. 20B

VID _v	NO _{v-i}	PK _u
VID1	NO1-1	PK347020
	NO1-2	PK001031
	⋮	⋮
VID2	NO1-365	PK314162
	NO2-1	PK141421
	⋮	⋮
VID3	NO2-77	PK789012
	NO3-1	PK123456
	⋮	⋮

FIG. 20C

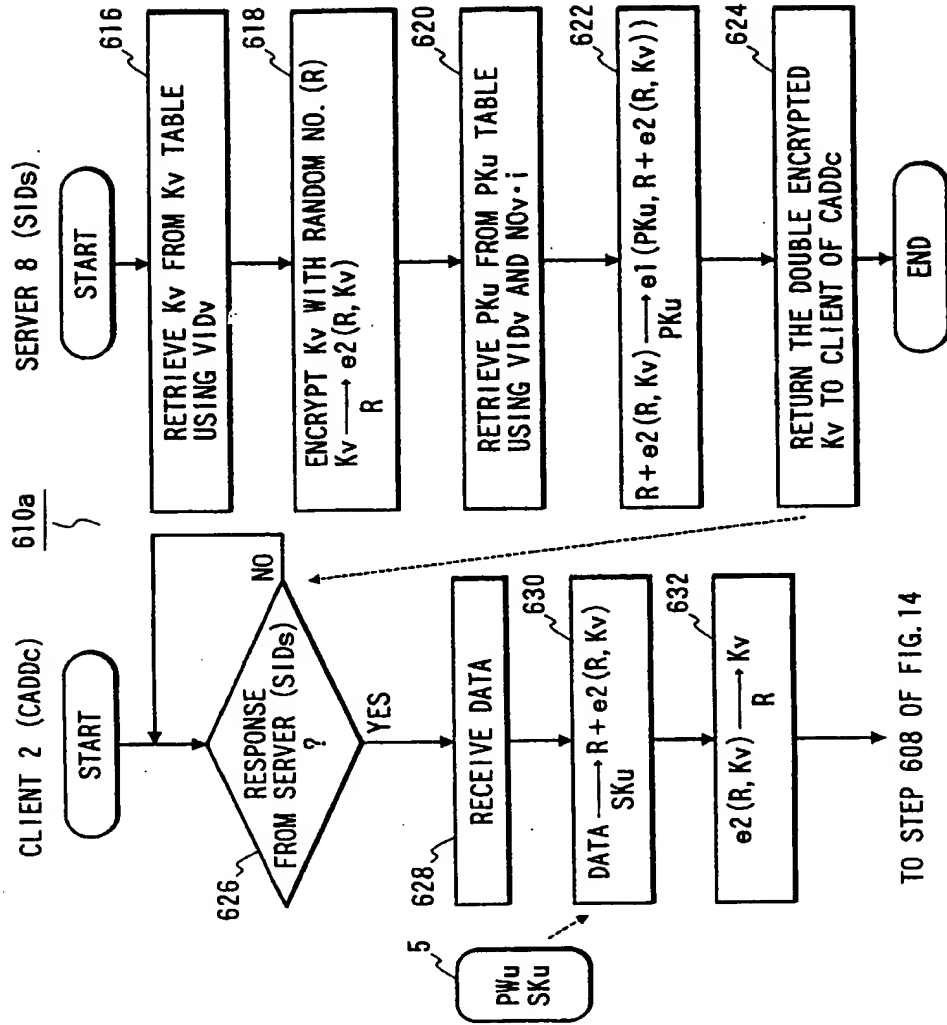


FIG. 21

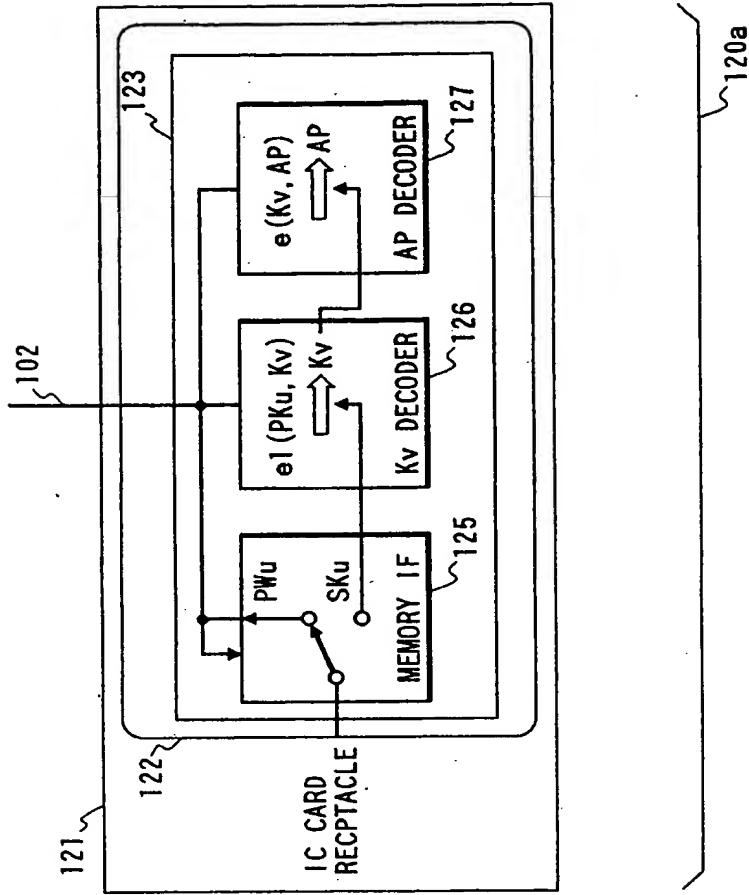


FIG. 22

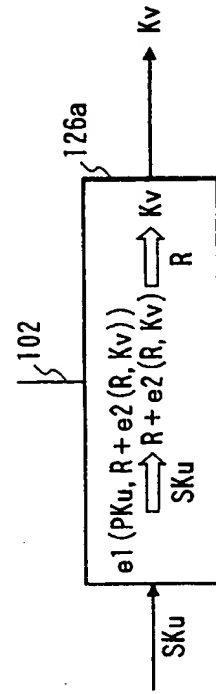


FIG. 23

THE HIGHER DIGIT OF TERMS-OF-USE CODE (HEXADECIMAL)	THE TERMS-OF-USE CODE IS APPLIED TO :
0	THE ENTIRE VOLUME
1	APPLICATION 1
2	APPLICATION 2
⋮	⋮

XYH (X, Y = 1, 2, ..., F)

THE LOWER DIGIT OF TERMS-OF-USE CODE (HEXADECIMAL)	CORRESPONDING LIMIT VALUE
0	NONE
1	NONE
2	THE EFFECTIVE DATE AND TIME
3	THE ALLOWABLE EXPIRATION DATE AND TIME
0	THE MAXIMUM AMOUNT OF USED PERIOD
0	THE ALLOWABLE ACCESS COUNT
⋮	⋮

FIG. 24

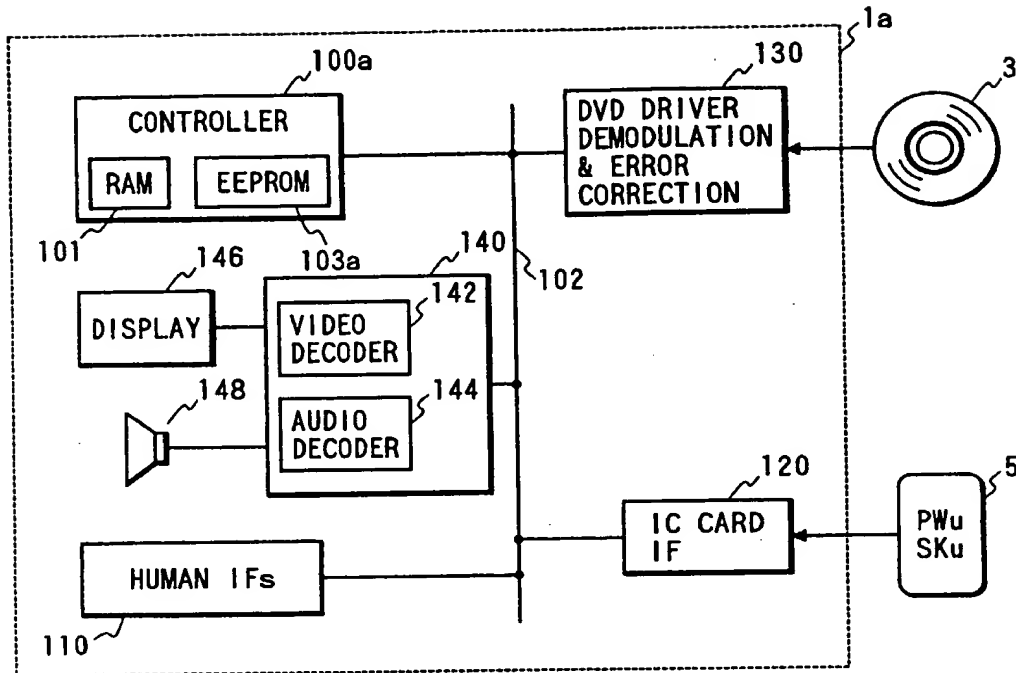


FIG. 26

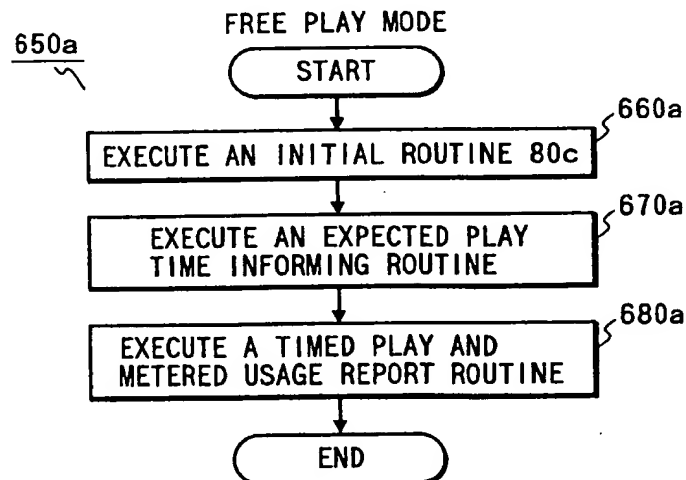


FIG. 25

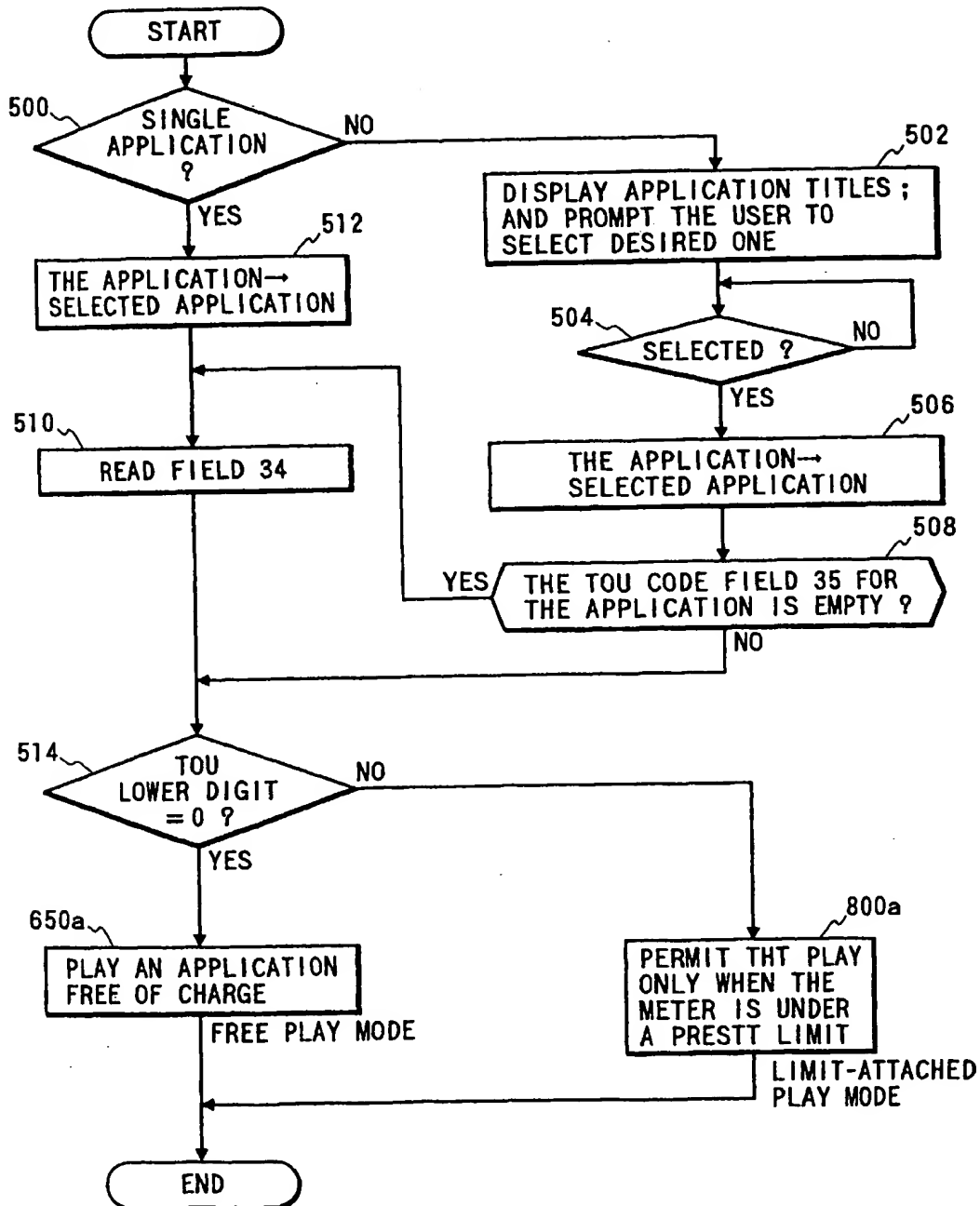


FIG. 27

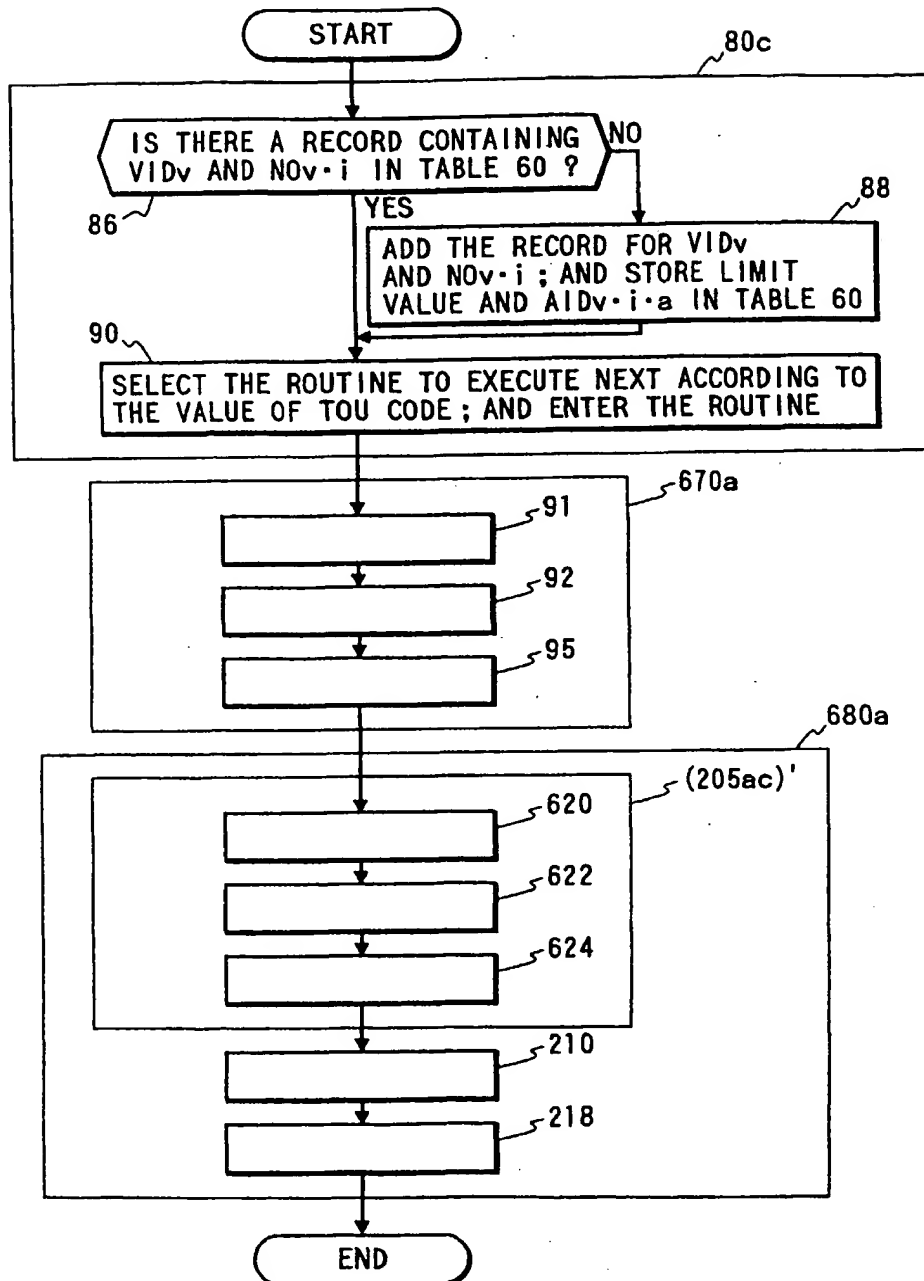


FIG. 28

LIMIT-ATTACHED PLAY MODE

